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APPLICATION OF BLOCKCHAIN TECHNOLOGY IN CORPORATION'S TRANSACTIONAL COST REDUCTION

Master's Thesis by the 2nd year student
Concentration – Master in Corporate Finance
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ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПОЛНЕНИЯ ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ

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Описание цели, задач и основных результатов	За последние 5 лет внимание к технологии блокчейн невероятно выросло. В рамках этой системы реализована работа множества криптовалют, все больше и больше компаний используют эту технологию для снижения издержек, проведения ICO и привлечения средств от инвесторов, для перевода документооборота и заключения умных контрактов. Некоторые государства уже признали биткоин в виде официального платежного инструмента, еще множество находится на пути к принятию подобного решения. Целью данной работы является оценка возможности применения технологии блокчейн для снижения транзакционных издержек компании. Для достижения этой цели было решено несколько задач. Во-первых, был производен детальный разбор принципов работы технологии блокчейн, порядок проведения децентрализованных платежей через нее и основные особенности криптовалюты биткоин. Во-вторых, была проанализированная традиционная централизованная система платежей и произведено сравнение особенностей банковских платежей с платежами через блокчеий. В-третьих, была оценена

	выгодность от применения технологии в компании для снижения транзакционных издержек. Для оценки был применен метод Value at Risk. В рамках работы был рассмотрен кейс реальной компании и произведены расчеты, подтверждающие, что применение технологии блокчейн может снизить банковские затраты. Выводы данной работы демонстрируют, что использование децентрализованной системы платежей для совершения денежных переводов внутри компании снижает транзакционные издержки, однако, она может быть применима только вместе с традиционной банковской системой, дополняя, но не заменяя ее. Кроме того, использование криптовалют может быть рассмотрено как дополнительный источник дохода создаваемого в результате изменения валютного курса.
Ключевые слова	Децентрализованная, централизованная, система, платежей, банковские, транзакционные, издержки, блокчейн, биткоин, криптовалюты, VaR, Value, risk

ABSTRACT

Master Student's Name	Roman Alterman
Master Thesis Title	“Application of Blockchain Technology in Corporation’s Transactional Cost Reduction”
Faculty	Graduate school of management
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Description of the goal, task and main results	Over the past 5 years attention to the blockchain technology as a decentralized system of payments has incredibly increased. Within this system many cryptocurrencies have been implemented, more and more companies use this technology to reduce costs, conduct ICO and attract funds from investors. Some states have already recognized bitcoin in the form of an official payment instrument, lots of others are on the way to making such a decision. The goal of this paper is to evalute the possibility of using blocking technology to reduce transactional costs of the company. To achieve this goal several tasks have been accomplished. First of all, a detailed analysis of principles of blocking technology, the procedure for decentralized payments through it and the main features of the cryptocurrency bitcoin were carried out. Secondly, the traditional centralized system of payments was analysed and a comparison of bank payments with payments through the blockchain was performed. After this the profitability of using technology in the company was evaluated. For valuation the Value at Risk method was applied. Within this paper the case of a real company was examined and corresponding calculations were made to confirm the fact that the use of blockchain technology can reduce banking costs.

	The conclusions of this paper confirm that the use of a decentralized payment system for intercompany payments reduces transaction costs, but, however, it can only be applied together with a traditional banking system, complementing each other. Moreover, the use of cryptocurrency can be considered as an additional source of income which could be gained as a result of the exchange rate changes.
Keywords	Decentralized, centralized, payement, system, banking, transactional, costs, blockchain, bitcoin, cryptocurrencies, VaR, Value, risk

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Introduction

Over the past decade the impact of technologies on everyday life has grown dramatically. This trend continues today: modern technologies are integrated into the activities of all economic agents, enterprises and households. All of those use different kinds of technologies in their activities.

Development has affected all spheres of life. From the economic point of view, modern technologies help to optimize costs. Active development of Internet banks, online exchanges, mobile applications for cost accounting, servers that provide cloud storage. What is more progress has not bypassed traditional ways of conducting money transfers on the market between agents.

In 2009 appeared the bitcoin: today's the most successful cryptocurrency. Its popularity is constantly growing, every day thousands of new users around the world create bitcoin-wallets. More and more enterprises and services are starting to accept payment for their services in cryptocurrencies. There are forks of bitcoin - other cryptocurrencies working in a similar way, but with different parameters, thus giving users the choice of which cryptocurrency to use.

Along with the growing popularity of cryptocurrency, there is a growing number of disputes and discussions around this kind of money in the financial, political and public spheres. Many people believe that because of the complete anonymity of money transfers, bitcoins contribute to the development of the black market and provoke tax evasion. Others believe that this is a completely new and powerful tool for accounting, which reduces all kinds of costs stating from the banking for money transfers and losses on the payment of various commissions, ending with time costs for transactions.

Despite the disputes around the cryptocurrencies and the distrust of conservative users to them, the high growth rate of their popularity can not be denied. If the trend does not change, after a couple of decades, bitcoin will rightfully become a global currency. By analogy with payments in national currency for each state, international settlements will receive their own currency - bitcoin.

However one can not deny the fact that until now the cryptocurrencies remain to be a not fully understood market phenomenon. Despite a lot of scientific papers and researches published over the last couple of years, a whole series of issues remain unresolved. The fate of the bitcoins still seems unclear. Will this currency continue to grow in its popularity and become a customary method of conducting payments on a par with the already familiar to all users of electronic money, or will the bitcoins never leave the limited range of Internet users? The answer to that question can give only the development of economics with time.

As it was mentioned above all of the agents in economics are trying to reduce their costs by applying modern technologies. The potential of blockchain technology to do this is unlimited. Nowadays a millions of different companies operate on the market starting from small businesses and ending with huge international corporations. Big international companies are often in need to transfer money between their branches in different countries. The traditional method of performing those payments assumes the participation of intermediary in the process of money transfer. This intermediary is represented by a bank – the bank which maintains company's accounts. To make those transfers through a traditional banking system company needs to pay to the bank so they take transactional costs. What is more it takes time to perform the payment. Sometimes commission and costs are huge and it is impossible to perform the payment urgently.

The goal of that paper is to evaluate whether it is possible to use blockchain technology in corporations to reduce their transactional costs which they take on transferring money between their branches and to evaluate the profitability of moving from the traditional technology to the blockchain taking into consideration pros and cons of both methods.

To achieve this goal it is necessary to perform the following tasks:

- To analyze deeply the blockchain technology in general and the principles of bitcoin payments in particular;
- To find out the differences between the traditional and decentralized payment systems;
- Calculate the costs and profitability of applying the blockchain payment technologies in the corporation;
- To carry out an empirical case study aimed to develop the working model for the big international company;
- To sum the paper up, to draw conclusions on the work and to formulate a list of managerial future references.

Chapter 1. Blockchain and Bitcoin

1.1 Cryptocurrencies

Cryptocurrency is a type of digital currency, which is issued and accounted by users, not by government agencies. The functioning of the system is decentralized in a distributed computer network.

Cryptography for the purpose of confidential payments is used since 1990. For the first time, the term "cryptocurrency" was used after the appearance of the bitcoin peer-to-peer payment system, which was developed in 2009 by a person or a group of individuals under the pseudonym of Satoshi Nakamoto using the proof-of-work system. Later, other bitcoin-independent cryptocurrencies, called forks appeared: Litecoin (increased the upper limit of total emissions, reduced the transaction confirmation time), PPCoin (no upper limit on the total volume of emissions), Novacoin (emission-related coefficients were reduced). Also, many other forks were created, but most of them do not carry anything new (either they are an exact copy of bitcoin, or the differences are limited only by the values of the limit and the rate of emission and / or the hash algorithm) and not widely used. Most of these forks appeared against the background of two large bubbles in the bitcoin market in 2011 and 2013, accompanied by increased media attention. (Empson, 2016).

Until July 2013 all cryptocurrency software except XRP (Ripple) was based on the open source code of the bitcoin system. Starting July 2013 self-developed platforms began to be launched, which, in addition to cryptocurrencies, support various crypto-infrastructure - exchange trading, shops, messengers and so on. Such cryptographic platforms include: BitShares, Mastercoin, Nxt; Announce and other platforms.

Cryptocurrency does not have a forced refund by default, but there are opportunities for transactions involving an intermediary when the consent of all three or arbitrary two parties is required to complete or cancel the transaction. Funds can not be forcibly frozen or seized without access to the owner's private key, but parties of agreement may voluntarily temporarily block their funds as collateral.

Usually there is an upper limit to the total volume of emissions. However, some cryptocurrencies, such as PPCoin, Novacoin, Sifcoin and others, do not have a fixed upper limit for the total volume of emission, and it is possible both for emission from existing savings and for issuance by mandatory destruction of a small fixed amount in each transaction.

All currently existing cryptocurrencies are used anonymously - all transactions are public, but there is no binding to a specific person, but the user's identity can be established if the necessary additional information is known.

Bitcoin

As it was mentioned before, today there are many different cryptocurrencies. The most common cryptocurrency is bitcoin. In this part, we'll figure out why bitcoin gained such popularity, despite the difficulty of understanding this type of money for an ordinary user.

The basic element of this payment system is an open source client program. These clients are launched on multiple computers using an application layer network protocol, and then connected to each other in a peer-to-peer network. It means that such a payment system will require protection. To ensure the protection and smooth functioning of the system, cryptographic methods are used.

The payment facility used in the bitcoin system is a digital coin - a cryptographic entity that meets certain requirements.

The quotation of bitcoin is based on trust in it, it is formed exclusively by the balance of supply and demand, is not tied to any currency or other asset. Unlike traditional money the bitcoin system does not have an organ (central bank or state) that would seek to provide liquidity at a given level, committed itself or obliged others to accept payment in bitcoins or could artificially reduce its purchasing power through additional emission. bitcoin is rather an electronic cash, rather than a debt obligation of the issuer, which distinguishes it from traditional electronic money and non-cash payments. (Kelly, 2015).

It is often asserted that emission limitation is a defense against inflation. A number of authors believe that a limited number of bitcoins is not a sufficient condition for guaranteeing the growth trend of the exchange rate, since one more prerequisite for this is an increase in the volume of supply of goods and services for bitcoins and services associated with it. That is, the non-speculative value of bitcoins directly depends on the volume of only those goods and services that can be purchased for them, rather than the global commodity mass. The emission and turnover of bitcoins are completely decentralized, independent of any regulatory body, the volume of emissions is known in advance. Data on the movement and emission of bitcoins are stored in a distributed database. Bitcoins can be sent to any other user of the system. In this case, you can use any fractional amounts to within the eighth character after the decimal point. All transactions are publicly available, but without disclosure of information about the real owner.

Each user can create an unlimited number of addresses. To improve anonymity, it is recommended that you make a new recipient address for each transaction. In general, addresses do not carry any information about the owner and are anonymous. The text form is a string of 34 characters in length, which consists of letters of the Latin alphabet and numbers. For example, the address might look like 1BQ9qza7fn9snSCyJQB3ZcN46bibitcoint4ee. Also, the bitcoin address can be provided as QR codes and other two-dimensional barcodes that are read by

mobile devices. The user of this payment system can create several addresses on his own initiative. The process of creating a new address is the creation of a new key pair, with no connection to the network required. To preserve anonymity, it is supposed to create addresses for only one correspondent or for one transaction. On the user's computer, a purse file is stored, which is the store of funds. Bitcoin can be sent to any user on the network using the bitcoin address.

The principle of a peer-to-peer network and the absence of an administrative center make it impossible for the state or private regulation of the system, as well as manipulation of the change in the total number of bitcoins. (Nakamoto, 2008)

Emission is carried out automatically: new bitcoins are received relatively randomly by those who use the computing power of their equipment to maintain the bitcoin system (to create new base units). The volume of emission is algorithmically limited so that the total number of issued bitcoins does not exceed 21 million. Initially, the amount of remuneration for each block created was 50 bit coins. After the formation of every 210000 blocks (approximately every 4 years), the amount of compensation will be reduced by half. On November 28, 2012 there was the first reduction of the emission component of the award from 50 to 25 bitcoins. At 6930000 block (approximately in 2131) the issue will be stopped altogether (remuneration 50 → 25 → 12.5 → ... → 0). The formation of the blocks will continue, but for them there will no longer be a reward for the emitted bitcoins. The system provides an opportunity to charge a commission for processing transactions from participants. At present, payment of such a commission is possible on a voluntary basis, but is not mandatory. It is assumed that when the fee for a new block in the form of an issue is significantly reduced, the main source of incentives will be commission fees. Payment of the commission speeds up the transaction. (Antonopoulos, 2014)

For each type of bitcoin user, this currency is interesting from different angles. For example, investors and managers of start-ups from Silicon Valley see a new subversive technology with huge potential, speculators - a high-speed tool for turnover of finance, where you can multiply the profit by using it at the right time, and programmers - a new software that was previously unavailable for use. As mentioned earlier, bitcoin is a decentralized currency. There is not a single center in the world that could issue or control this currency. Also, there is no possibility to influence its course, the number of coins that turn into the network, you can not block an account or transaction. The p2p network consists of only peer-to-peer nodes. With your money that you earned or received as payment for a product or service, only you can dispose of it. No one has the right to freeze your personal account, or cancel the payment, or prohibit users from accepting and sending currency.

The emission is limited, it is already programmed, so its move is known to all participants who are associated with bitcoin, in advance. The total amount of monetary units will not be able to exceed 21,000,000 BTC. The volume increases as the sum of a decreasing geometric progression and approaches the asymptote with a maximum value of 21,000,000 BTC. Coins appear on the network in batches (blocks) with a periodicity of 10 minutes. In each pack there is a certain number of coins, at the moment it is equal to 25, but every four years it decreases by half. Initially, 50 coins were in the package, but on November 28, 2012 this number was halved. Deflation is expected in the future, but this will not be a problem, since the currency is divided to the 8th decimal place.

Based on the foregoing, we can conclude that bitcoin is rather electronic gold, and not a simple currency for payment for services and goods on the Internet. This resource is exhausted, the more mining (mining) of BTC coins at the moment, the harder it is to extract in the future. It can not be copied. Theoretically, the value of electronic coins will only increase in the future. Double use of the same bitcoin to pay for something impossible. This will not miss the algorithm of the system operation and cryptographic protection.

At the moment, the BTC currency is accepted as payment in a variety of stores and services. There are assumptions that bitcoin will occupy a certain niche in electronic payment systems and will make traditional currencies move.

1.2 Blockchain technology

As it was mentioned in the previous part bitcoin protocol is based on the blockchain technology.

Modern technologies allow people to communicate directly. Voice and video calls, e-mails, pictures and instant messages travel directly from individual to individual maintaining trust between them no matter how far apart they are. When it comes to money people have to trust to third party to complete a transaction. Blockchain technology is challenging the status quo in a radical way. By using math and cryptography blockchain provides an opened decentralized database of every transaction including value, money, goods, property, work or even votes creating a record whose authenticity can be verified by the entire community. The future global economy will move towards one of distributed property and trust where anyone with access to the internet can get involved to the blockchain based transactions and third party trust organizations may no longer be necessary.

The uses of blockchain technology are endless. Some expect that in less than 10 years it will be used to collect taxes. It will make it easier for immigrants to send money back to countries where access to financial institutions is limited. Financial fraud will be significantly

reduced as every transaction will be recorded on a public and distributed ledger which will be accessible by anyone who has an internet connection.

Think of it as wills and contracts that execute themselves or dated proof of existence for ideas, much like a patent. Blockchain will become a global decentralized source of trust but not everyone is ready to embrace it. A huge proportion of trust services from banking to notaries will face challenges on price, volume and in some cases their very survival.

Public authorities could find it more and more difficult to enforce traditional financial regulations due to the new possibilities offered by the cryptocurrencies network to bypass traditional financial intermediaries. Unimagined new networks will evolve to meet society's needs more cheaply and potentially more securely.

Generally speaking, blockchain is a chain of transaction blocks built according to certain rules. For the first time the term appeared as the name of a distributed database implemented in the base of bitcoin cryptocurrency. (Popper, 2016)

A blockchain is a special structure for recording of a group of transactions in the bitcoin system and similar ones.

For a transaction to be considered valid ("confirmed"), its format and signatures should be checked and then the transaction group should be written into a special structure - a block. The information in the blocks can be quickly re-checked. Each block always contains information about the previous block. All the blocks can be aligned in a single chain, which contains information about all the operations that have ever been performed in this database. The very first block in the chain - the primary block (or the genesis block) - is treated as a separate case, since it does not have a parent block. (Deloitte, 2015)

The block consists of a header and a list of transactions. The block header includes its hash, hash of the previous block, hash of transactions and additional service information. In the bitcoin system, the first transaction in the block always indicates the receipt of a commission, which will be awarded to the user for creating of a new block.

Next are all or some of the latest transactions that have not yet been written to the previous blocks. For transactions in the block a tree hash is used, similar to the generation of a hash-sum for a file in the BitTorrent protocol. Transactions, in addition to giving commission for creating a block, contain a reference to the transaction with the previous data state inside the attribute input (in the bitcoin system, for example, a reference is made to the transaction where the consumable bitcoins were obtained). Commission transactions may contain in the attribute any information (for which this field is called the "Coinbase parameter"), since they do not have parent transactions.

The created block will be accepted by other users if the numerical value of the hash of the header is equal to or lower than a certain number, the value of which is periodically adjusted. Since the result of hashing (SHA-256 function) is irreversible, there is no algorithm for obtaining the desired result, except random enumeration. If the hash does not satisfy the condition, the nonce parameter is changed in the header and the hash is recalculated. Usually a large number of conversions is required. When a variant is found, the node sends the received block to other connected nodes that check the block. If there are no errors, then the block is considered added to the chain and the next block must include its hash.

Blocks are simultaneously formed by a set of "miners". Satisfactory blocks are sent to the network and are included in a distributed base of blocks. Often situations arise when several new blocks in different parts of a distributed network call the previous one the same block, that is, a chain of blocks can branch. Specifically or accidentally, it is possible to limit the retransmission of information about new blocks (for example, one of the chains can evolve within the local network). In this case, parallel build-up of different branches is possible. In each of the new blocks, there can be both identical transactions, and different ones, which are included only in one of them. When relaying blocks resumes the miners begin to consider the main chain taking into account the level of complexity of the hash and the length of the chain. If the complexity and length are equal, the preference is given to the chain whose end block appeared earlier. Transactions that have entered only the rejected branch (including payment of compensation) lose the status of confirmed. If this is a transaction for bitcoins, it will be queued and then included in the next block. Transactions of receiving rewards for creating cut-off blocks are not duplicated in another branch, that is, the "extra" bitcoins paid for the formation of cut-off blocks do not receive further confirmation and are lost. Thus, the chain of blocks contains a history of possession, which can be found, for example, on specialized sites. (Carrick, 2016)

The distributed database Blockchain is formed as a continuously growing chain of blocks with records of all transactions. A copy of the database or its part is simultaneously stored on a variety of computers and synchronized according to the formal rules for building a chain of blocks. The information in the blocks is not encrypted and is available in plaintext, but is protected from cryptographic changes through hash chains.

The database publicly stores in an unencrypted form information about all transactions that are signed using asymmetric encryption. To prevent multiple waste of the same amount, timestamps are implemented by splitting the database into a chain of special blocks, each of which, among other things, contains the hash of the previous block and its serial number. Each new block carries out confirmation of transactions, the information about which contains and additional confirmation of transactions in all previous blocks of the chain. Changing information

in a block that is already in the chain is not practical, since in this case it would be necessary to edit the information in all subsequent blocks. Thanks to this successful double-spending attack (re-spending previously used funds) in practice is extremely unlikely.

Most often, deliberate change of information in any of the copies of the database or even in a fairly large number of copies will not be recognized as true, as it will not comply with the rules. Some changes can be made if they are included in all copies of the database (for example, deleting several last blocks due to an error in their formation).

To more clearly explain the mechanism of the payment system Satoshi Nakamoto introduced the concept of "digital coin", defining it as a chain of digital signatures. Unlike the standardized denominations of conventional coins, each "digital coin" has its own denomination. Each bit-address can match any number of "digital coins". With the help of transactions, they can be divided and merged, while the total amount of their denominations minus the commission remains.

We can show how blockchain works on basic level by using a bitcoin example (figure 1). Like all the information transferred by blockchain technology bitcoin uses cryptography to validate transactions, which is why digital currencies often referred to as “cryptocurrencies”. bitcoin users gain access to their balance through a password known as a private key. Transactions are validated by a network of users called “miners”. Miners donate their power in exchange for the chance to gain additional bitcoins using a shared database and distributed processing.

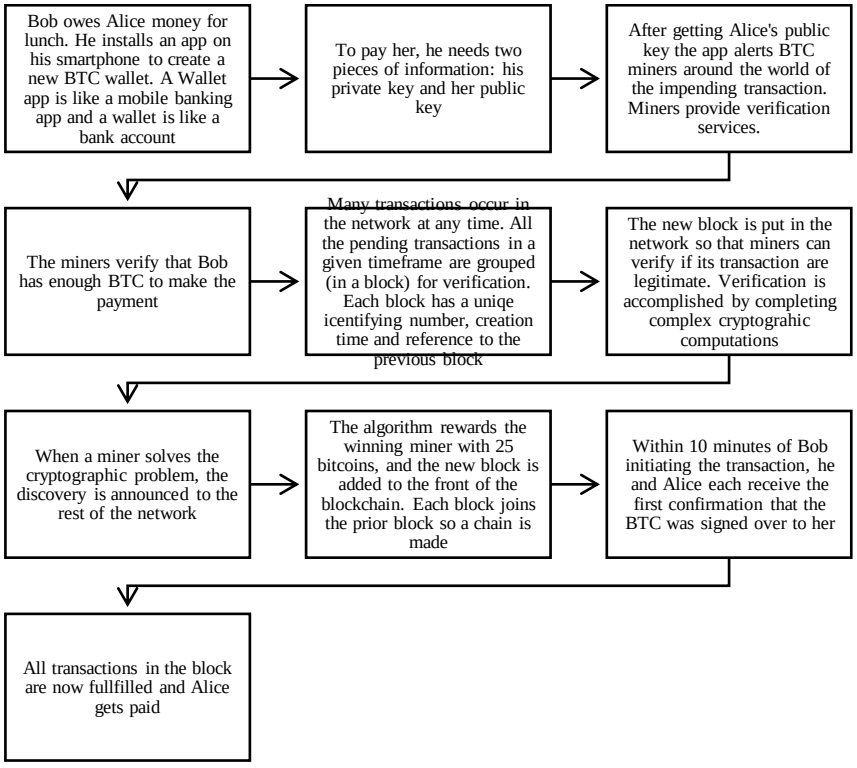


Figure 1. Blockchain working scheme

1.3 Mining

The activity on the creation of new blocks with the possibility to receive remuneration in the form of issued bitcoins and commission fees was called "mining". Produced computations are required to provide protection against the re-use of the same bitcoins, and the connection of mining with emissions stimulates people to spend their computing power and maintain the network.

Mining can be done both alone (solo-minining) and jointly, using the services of specialized web services, which are called "pools". Users provide the pool with their computing power. The peculiarity of the problem makes it possible to apply the maximum parallelization of computations, when each participant searches for his variant of the solution without linking his results with the solutions of others. In turn, the pool, implementing the solomining, distributes the obtained bitcoins between users, in accordance with the rules established by the pool owner. The main reason for pooling is to reduce the risk of long-term failure to receive rewards. The probability of obtaining a reward by a solo miner in an arbitrary ten-minute period is approximately equal to the ratio of its computing power to the computing power of the entire network. And if this ratio is very small, then the probability of obtaining a reward even over a long period of time will also be low. (Vance, 2013)

In the first versions of the client, there was a button to "generate new bitcoins", but after creating software for mining on video cards, the mining used by the client with the help of the CPU turned out to be unprofitable because of the low probability of getting a reward and the button was removed.

Currently, the mining on video cards has also become unprofitable, and the network uses specially designed for mining integrated circuits.

The transfer of bitcoins is carried out directly, without intermediation of any financial organizations. The cancellation of standard transactions is not possible, but it is possible to use multi-signatures, including for transactions involving an arbitrator.

Exchange of bitcoins

If it is not planned to be engaged in mining (producing bitcoins on its own), then exchanges can provide this currency.

There are 4 main exchanges that occupy most of the market. There are also a lot of smaller exchanges, but the largest number of BTC currency turnover occurs on such large exchanges: MTGox, Bitstamp, BTC-E, BTCchina.

MTGox is the very first exchange, which started the currency turnover of bitcoin. At the moment it is also the largest stock exchange. As you know, the cryptocurrency fell sharply and rose again in accordance with the dollar exchange rate, therefore, it was on this exchange that all

changes in the rate of the Internet currency occurred. Until 2013, about 80-95% of all trading was controlled here, and in 2013 the exchange began to take the leader's position, as pressure was exerted on it by the US authorities. (BBC, 2014)

Bitstamp. The second exchange under the account, is based a bit later, than MTGox. The currency for the withdrawal of bitcoin is only the US dollar. At the moment, the exchange generates up to 50% of the money turnover with the crypto currency.

BTC-E is a stock exchange on the Russian market. Works with the withdrawal of BTC in rubles, dollars, euros, and also exchanges for other crypto-currencies, created by the principle of bitcoin. It takes about 40% in the market of coin trades.

BTC China is a Chinese stock exchange with trades in yuan currency. Since 2013 on this exchange, trade volumes have exceeded the volumes of MTGox market leader by 2 times.

There are so-called exchangers of electronic currencies, in other words - fixed rate exchangers. They act as intermediaries between exchanges and customers, collecting from the latter a small fee (commission) for the services provided. As an advantage of exchangers, a simpler and quicker procedure for buying or selling, as well as a slightly expanded choice of payment methods, which include local banks.

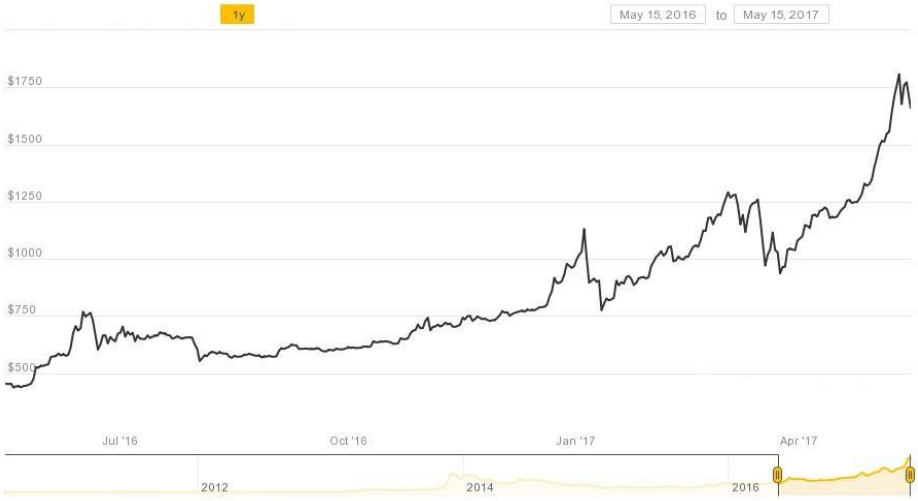
Bitcoin rate

It is known that bitcoin coins have value, since they are useful as electronic money. They have characteristics of ordinary money, for example, durability, deficiency, interchangeability, portability, recognizability and divisibility. These characteristics are based on mathematics, but in no case rely on physical property, such as precious metals, or on trust in a centralized authority, for example, as in the case of fiat currencies. In the case of crypto currency, all those characteristics can increase with the growing number of users, entrepreneurs and start-ups. As with all currencies, the value of BTC can only be determined by people who wish to accept them as a means of paying for services and goods.

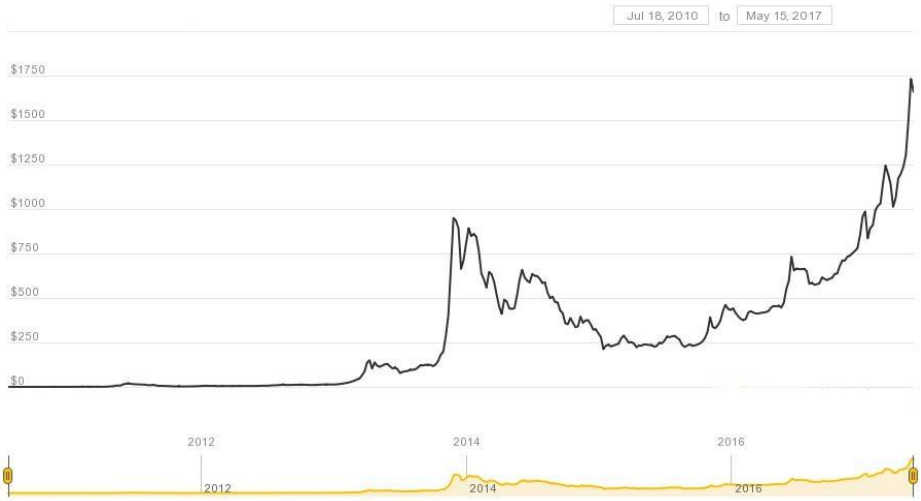
What exactly determines the cost of bitcoin? This is supply and demand. When the demand for this coin increases, so does the price for it. And when the demand decreases, then the price falls. As mentioned earlier, there is a limited number of bitcoins in an accessible circulation, which means that demand should follow this inflation rate so that the price remains stable. Since the bitcoin market is still relatively small, it will not take large sums of money to move the price of coins up or down. That is why the price of bitcoin is still unstable.

This raises the question: can the bitcoin currency depreciate? As a general rule, no single currency can be absolutely insured against collapse. But BTC has proven its reliability over the years of its existence. This coin has considerable potential for growth. But no one can predict what the future expects this crypto currency. (2017)

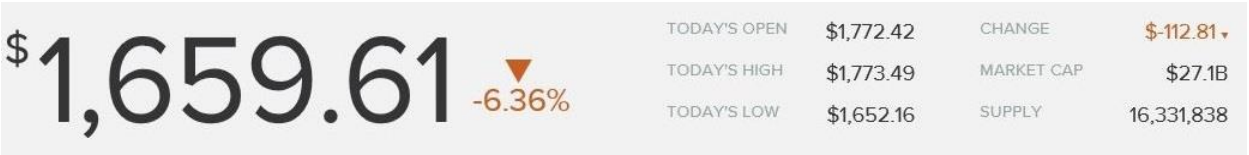
On the graphs below bitcoin rate change is presented.



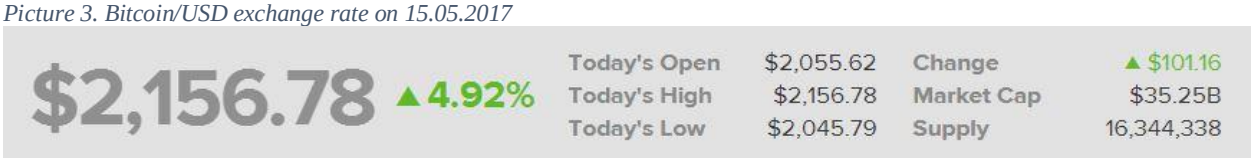
Picture 1. bitcoin/USD exchange rate graph. 1 year



Picture 2. bitcoin/USD exchange rate graph. All the time



Picture 3. Bitcoin/USD exchange rate on 15.05.2017



Picture 4. Bitcoin/USD exchange rate on 22.05.2017

Picture 5. Bitcoin/USD exchange rate on 31.05.2017

1.4 Bitcoin protocol performance

A proper understanding of the details of the bitcoin protocol makes it possible to examine this currency in more detail and the principle of its operation. In particular, BTC is the basis for understanding the built-in scripting language, or in other words, the scripting programming language. The coin itself makes it possible to use it for new types of instruments in the financial system, for example, such as smart contracts. These financial instruments can be used to create markets and new forms of collective behavior.

As mentioned earlier, bitcoin is based on cryptography. It is cryptographic protocol - the most reliable for protecting the currency, the user, the device from which all transactions are made.

The creation of the cryptocurrency

To fully understand the operation of the crypto-currency protocol, it is necessary to understand the creation of a protocol in stages. The most likely question to consider is how can a user create a digital currency? If we say simple for understanding the language, consider two users: a user under number 1, who intends to transfer to the user under number 2 a certain amount of bitcoin. To do this, user 1 should write a message with certain content about his intention to transfer to user number 2 one coin of bitcoin. Then he signs this message in digital format with the use of a crypto-switch, and then he already announces the signed digital bit string of the entire bitcoin network.

This type of payment at first sight seems imperfect, but it is not. Since the bit string is public, any user can check that it was the user at number 1 who was the person who wrote the message about the transfer of one bitcoin to the user at number 2. This also ensures that user number 1 can not cancel the currency transfer, so As he previously wrote, that it is he who transfers one bitcoin. Also this message, compiled by the first user, gives him a guarantee that no one except himself could make such a message. This is a limited protection against forgery. But if this message is public, then after its appearance on the network someone else could use this signature. But this can not be done from scratch.

During the creation and transfer of the crypto currency, two properties were defined: the establishment of intent from the user number 1 and the counterfeiting protection, but a little limited. These properties are notable features of the bitcoin cryptographic protocol. It is also worth noting that it is the message about the transfer of the bitcoin currency by the user is digital money. That sequence of bits, which is obtained as a result of using a crypto switch when the message is digitally rewritten.

Serial number of the coin

The problem in the transfer of one bitcoin by the first user to the second is that the user number 1 can write to the user at number 2, for example, 15 such messages about the transfer of one coin. Will this mean for all network users that the first user has transferred all 15 bitcoin to the second one or does he prove that it is he who passes BTC to number 2 user? In order to make a coin unique, she needs to assign a serial number. Then the user who intends to transfer one bitcoin should add that the coin with serial number 8594526, for example. And if the user number 1 decides to transfer the coin, he should already indicate that he is transferring coins with the serial number 8932568. And no one in the crypto currency network will doubt that the new coin was transferred.

In order for the above scheme to work, you need a reliable source with serial numbers for bitcoin. One of the many ways to obtain such a source is to open a bank. He will provide a serial number for coins, as well as track those who have a currency, and verify that the transactions are truly legitimate. To verify the legitimacy of the transaction, user number 2 is enough to contact the bank after he received a message from the first user about the transfer of bitcoin with serial number 8594526. Then he checks that the coin with serial number 8594526 actually belongs to the first user, and user number 1 has not yet spent this coin.

If the conditions are correct, the recipient informs the bank that it accepts one bitcoin, and the bank updates its records to display for all users of the network about the coin ownership with serial number 8594526 by user number 2. (Swan, 2015)

The creation of banks

The idea is that everyone separately and in aggregate was a bank. Assuming that all bitcoin users store all records of who owns the coins, this can be called a blockchain. It is this name that has a public record of all transactions.

Suppose user number 2 was informed of the intention of user 1 to give him one bitcoin. For verification, he uses his own chain of blocks, with a positive result, he sends simultaneously a message to the payer and the entire network of users about the acceptance of the transaction. After that, everyone updates their block chains.

There may also be a problem if the first user wishes to transfer the same bitcoin to the user number 3. This can happen because a certain time appears when the user 2 does not know that the user 3 is also the recipient of the same bitcoin. Provided that both recipients will do the check at the same time, they will see. That this bitcoin is the property of the user number 1. Both users will accept the transaction, but after that there will be a problem about double spending.

To avoid this, the user needs number 2, provided that he is notified of the transaction first, update his block chains. Then they will update all users. Then the deceived user number 3

will no longer be able to confirm the transaction, and double spending will not occur. But the sender can deliberately increase the waiting period, for example, disrupt the communication of both users or delay communication for a split second.

A more correct option would be to broadcast the second user transaction across the entire bitcoin network. Then already all users will determine whether the transferred transaction is legitimate. And with a positive result will update their chain of blocks. Then already the user at number 3, whom they wanted to deceive, will not become such. He can not confirm that the coin bitcoin belongs to the user number 1. (Deloitte, 2015)

But if you consider that the verification by all users of the network can not be carried out for the reason that it is not known how many users are online. From this statement it follows that to confirm the legitimacy of the transaction requires confirmation of a sufficient number of users about the correct transaction. But what exactly does "a sufficient number of users" mean? No one can at this point determine this, since initially there is no fixed proportion of users on the network to confirm the transaction.

Working capacity of the system

Let’s suppose that user number 1 has an automated system for setting up a large number of individual users, for example, a billion. As before, he will try to offer the same bitcoin to two users. But they, in turn, will be asked to check transactions on the network. Additional users that are available to the payer will confirm the transaction by informing deceived recipients about the correctness of the transaction. Thus, they can deceive one or both users at the same time.

There is a way to avoid such a problem. To do this, you can use an idea that is known in the bitcoin network called proof-of-work. This is a combination of two other ideas: making a confirmation of the transaction artificial to the user, which will require the cost of its computing power; Reward users for help in verifying the transaction.

The benefit of costly transaction verification helps to avoid dependence on the number of network users that can be controlled by someone. Only the total (total) computer processing power will be able to exert pressure on the verification of the transaction. Using a single algorithm to check a fraudster may require significant resources to deceive, which makes a deliberate illegitimate transaction

Vulnerability of the system

Bitcoin technology - protocol and cryptography - has a high level of payment history protection, and the bitcoin network is arguably the largest project in the world with distributed computing.

The highest vulnerability is network users' errors. Bitcoin files of the wallet that store the necessary private keys can be accidentally deleted, stolen or lost. This type of danger is typical

for physical cash, which is stored electronically. Fortunately, users can use excellent security to protect their money, or use services that provide good levels of protection and insurance against theft and loss. (Tapscott, 2016)

From the statement above, the question arises: could bitcoin be hacked in the past? The rules of protocol and encryption used in bitcoin still work, years after their creation, which is a good indicator of an excellent and well-coordinated concept. However, security flaws have been and are being corrected over time in different cases when implementing software. Like any other software, the security of bitcoin software depends on the speed with which these problems are located and solved. The more such problems are found, the more perfect bitcoin becomes.

There are always misunderstandings about stealing and miscalculations in safety, which happen on various exchangers and entrepreneurs. And although these cases are not planned, none of them is connected with the hacking of bitcoin itself and does not imply the inherent disadvantages of the network. More specifically, users need to provide a set of good habits and intuitive security solutions to make their money more sophisticated and improved, and to reduce the overall risk of theft and loss. Over the past few years, security features have been quickly developed, for example, encryption of wallets, offline wallets, devices for storing bitcoin currency, transactions that require several signatures, and a Bitfury chip.

Also, the subject of the bitcoin system security can be attributed to a money transfer in the event that the recipient's computer is turned off. On this account, worry about the network should not be, since coins will appear the next time the user launches the virtual electronic wallet application. bitcoin is, literally, not a program on the local computer, but it's coins that are added to the public public registry, which is located on all devices that are on the network.

If a user sents a currency, when the wallet program was not started and if it starts later, the program will download the chain of blocks and determine all the transactions that it has not received notifications about. All bitcoin tools will appear in your wallet immediately, as if they had just been sent to the recipient. In fact, the wallet is needed just to spend coins.

If we consider that bitcoin is a public network with transaction data, then the question is ripening: can network users collude against it? The answer is negative, since it is impossible to change the payment system protocol by simple methods. Any network client that does not or does not want to comply with the rules of the system can not impose its rules on other users. According to the existing specification, it is not possible to double expenses in the same chain of blocks, as well as to spend coins without signing or confirming.

Therefore, based on the above, no one has the opportunity to create an uncontrolled amount of currency from the air, nor can one spend other people's money, harm the network or commit any unauthorized operation.

However, it should be noted that a large number of miners can arbitrarily select, block or reverse current transactions. Most users can insist on making some changes to transactions and money turnover. The bitcoin system works correctly only when there is complete agreement between the users. Changing the network protocol can be a very difficult task and will require the prevailing number of users to make the required changes. Therefore, the rest of the users will have no choice but to follow them and accept the conditions. But such a case remains unsupported by the logic: why do users who want to arbitrarily accept changes will try to compromise this particular action with their personal money? (Champagne, 2014)

1.5 The legal status of cryptocurrencies

Legal status of crypto currency is significantly different in different countries. In a number of countries, operations with bitcoins have been officially authorized, including as a payment instrument. In other countries, such operations are prohibited or severely restricted. Even in one country it is possible to meet, when different state institutions, ministries, courts treat bitcoins differently. In many countries, status has not yet been defined or changed. The rules and prohibitions that apply to bitcoins, most often similarly apply to other crypto-currencies. Consider the positions of several different countries in relation to cryptocurrencies.

European Union:

At this stage, none of the (egislative branches of the European Union did not accept any special rules of regulation of cryptocurrency activities. However, in 2016 The European Commission proposed establish an additional regulation for crypto exchanges and companies that provide cryptourrency wallets to users. In particular, it is proposed to provide compulsory registration or censoring the activities of crypto-exchanges for fiat money and vise-a-versa, and companies providing cryptocurrency user wallets. In addition, it is planned to create central database with information users of digital currencies.

In general, at the end of 2016, the legal regulation of cryptocurrency and operations with it took place within the framework of the counteraction policies legalization (laundering) of income, criminal proceeds, and terrorism.

Taxation of the cryptocurrency and with it is carried out in accordance with the with the national legislature. Member States of the European Union. An exception is the tax Value added, since in November 2015 European The Court (the European Court of Justice) decision in accordance with which operations for the purchase and sale of bitcoin for traditional fiat currencies to them are not assessed by VAT.

For example, in Norway, Finland and Germany, the Crypto-currency is subject to capital gains tax and wealth tax. In Bulgaria, the digital currency is regarded as a financial instrument

and is taxed accordingly. In Austria, the crypto currency is considered by the tax authorities as an intangible asset, and its mining - as an operating activity. Therefore, the income received as a result of its alienation is the income tax.

Russian Federation:

A possible ban on crypto-currency in the Russian Federation has been actively discussed over the past three years. In 2015, according to the National Agency for Financial Research (NAFI), the idea of a ban was supported by 40% of Russians. Despite this, the bill prohibiting the digital currency and, accordingly, transactions with it, has not been submitted to the State Duma for consideration. At the same time, at the state level, the idea of such a ban was replaced by the idea of regulating crypto-currency relations. The opinion of the population also changed: in 2016 only 20% of Russians advocated the banning of digital money (according to NAFI). At the same time, Russia can become the first state to adopt a law on the legal regulation of crypto-currencies and transactions with them.

Until today, the relevant legal regulation has not been worked out, and the existing statements of regulators are only informative. The letter of the Federal Tax Service of the Russian Federation can be considered quite progressive. In it, the regulator, in particular, noted that the current legislation does not prohibit the implementation of transactions using crypto-currency. At the same time, issues related to the taxation of digital currencies have not been resolved. For example the problem with their taxation of value-added tax. In general, the standard rules and tax rates are applied, as there are no special conditions for taxing crypto-currency transactions by legislation. During the period 2014-2016, the Federal Service for Supervision in the Sphere of Communications, Information Technologies and Mass Communications has blocked several information websites devoted to crypto-currencies and distributed technologies.

According to the Central Bank of Russian Federation official information Bitcoin payments are going to be legalized in the last quarter of 2017 year.

United States of America:

The United States of America is one of the most convenient countries in the world for conducting crypto-currency business. Large hedge funds, stock exchanges and other companies connected with the crypto currency are incorporated here, and for many goods and services it is possible to pay not only with phiatic or electronic money, but also digital ones. In the US ATMs (ATMs) are also common, which offer the possibility of exchanging fiduciary money and crypto-currency.

But the legal regulation of the digital currency in the United States is no less complicated than in Europe. This is mainly due to the peculiarities of the legal system of the state (the

presence of both federal law and state law) and the lack of a unified position among regulators regarding the legal status of the cryptocurrency. Thus, the digital currency is considered simultaneously as money (their analog), as property (property) and as exchange commodities.At the federal level, some crypto-currency companies (for example, Exchange) must be registered as translation operators funds in the Network for Combating Financial Crimes (Financial Crimes Enforcement Network). And at the state level, the activities of such companies is subject to licensing (in each individual state). As a property, digital money is considered for tax purposes. Operations with the crypto currency are taxed. For example, salaries paid to employees in bitcoin are subject to federal Income Tax Withholding and Payroll Taxes. (Lihuta, 2017)

1.6 Decentralized payment system

To go on with the research it is obligated to formulate the scheme of bitcoin payment process. Let's assume that we have 2 persons or companies which are A and B and which want to perform the payment between each other. The scheme would be the following:

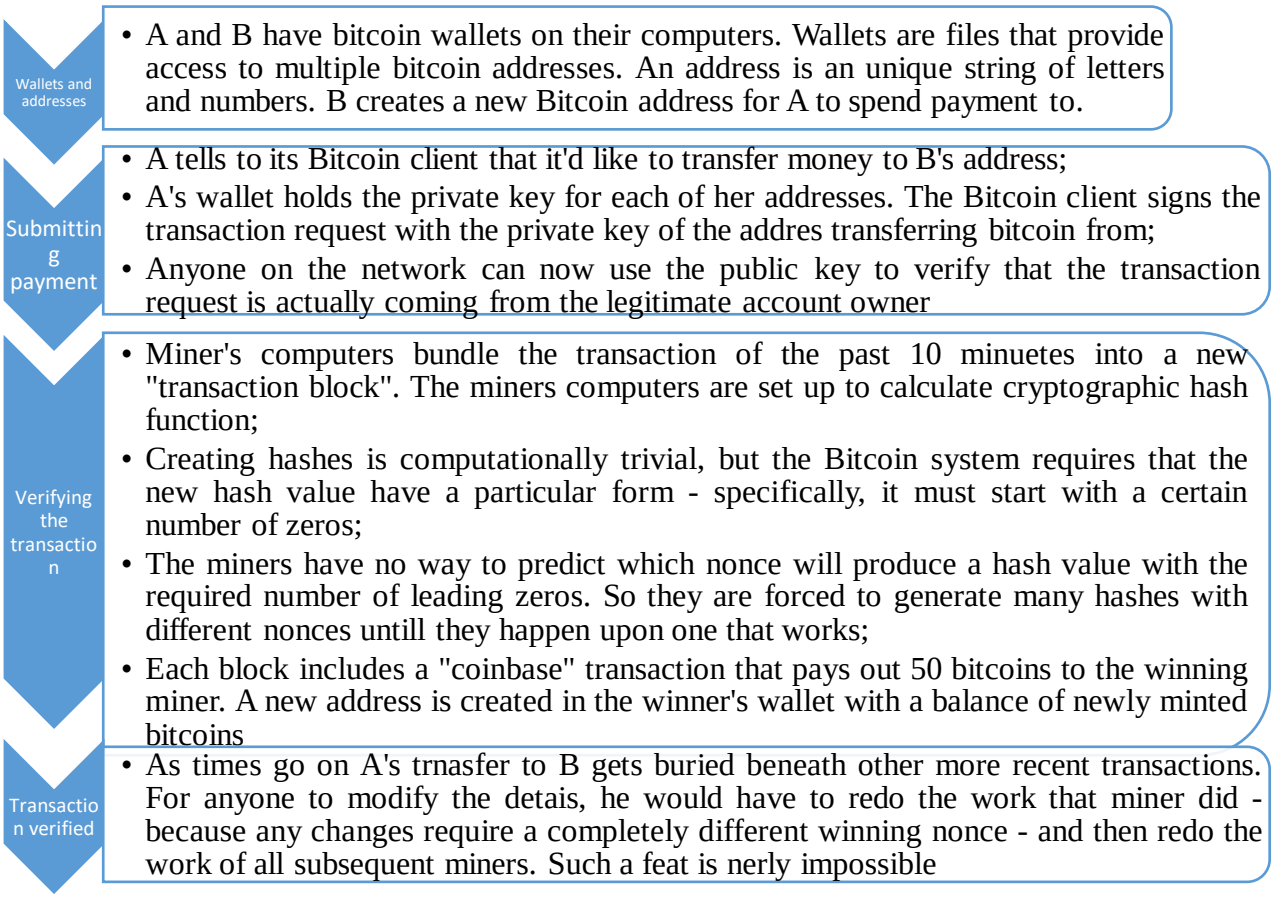


Figure 2. Bitcoin payment scheme

To sum up the first chapter it would be sensible to emphasize that some of goals were accomplished successfully. In the chapter above the theoretical aspects of blockchain and bitcoin

systems were explained and the regulation of cryptcurrency business in different countries was discussed. Afterwards as a result of the analysis performed the scheme of the payment through the blockchain system was built.

From the first chapter we can distinguish any advantages and disadvantages of bitcoin currency in comparison with other currencies. For example, you can compare bitcoin with fiat currencies, such as the euro, ruble or dollar.

Benefits:

• Practically free transaction;

• forwarding without delay;

• Protection against printing funds illegally;

• Possible ultra-small transfers - 0.00000001 bitcoin, which opens the way to new business models;

• Impossibility to block an account or refuse a legitimate transaction;

• There is no way to get a coin in an unauthorized way;

• Unlimited number of transactions;

• Relative anonymity.

The disadvantages are the following:

• A rather complex understanding of the purpose of the bitcoin system;

• The current version of the system has an uncomfortable user interface;

• It is quite difficult to recover a forgotten password;

• For everything that happens to the wallet, the user is responsible on his own;

• released software only in the beta version;

• Unstable exchange rate against the US dollar;

• The weight of the base file is too large with all transactions (about 20 GB), and later the size will only increase

Chapter 2. Traditional payment system and Blockchain

Each day every second millions of payments all around the world are performed. A huge part of them are done within the bank system. People are using debit and credit cards in shops, they transfer money to each other from their bank accounts, companies do transactions constantly. All of those money movements are done with intermediary which is a bank. Currently it could be considered as a traditional way of transaction performing.

While software and the Internet are making those transactions more convenient the financial assets being transferred still move over antiquated systems connecting clearing houses, corresponding banks and central depositories. It means that it can take days for funds to reach an account or a stock trade to settle. Not only this system is slow they are expensive and increasingly insecure.

The main difference between traditional system and blockchain is centralization. As it was shown above, payments through blockchain are decentralized and traditional way of performing transaction is centralized – with banks as intermediary.

With the development of a market economy there is a need to create an adequate financial infrastructure, including financial markets. With the development of industry and trade, the financial system is developing the banking system of society, which carries out its operations in the banking market (primarily trade in credit resources).

The term "system" is used to determine credit relations, banks and the organization of their activities. Most often, the word "system" means the composition of something. The content of the term "system" determines not only the composition of the elements, but also:

- A collection of elements;
- Sufficiency of elements forming a certain integrity;
- Interaction of elements.

The banking system is a holistic system that ensures its sustainable development.

As a set of elements it can be defined as:

The fundamental block:

- The bank as a monetary institution;
- Rules of banking.

Organizational unit:

- Types of banks and non-bank credit institutions;
- Bases of banking activity;
- Organizational basis of banking activities;
- Banking infrastructure.

Regulating unit:

- State regulation of banking activities;
- Banking legislation;
- Regulations of the central bank;
- Instructive materials of commercial banks.

The banking system is also defined as the aggregate of participants in the monetary market-commercial and specialized banks, non-banking institutions that perform deposit, loan and settlement operations and operate within the framework of a common monetary and credit mechanism.

Blocks and elements form a unity, reflecting the specifics of the whole and acting as carriers of its properties. The banking system has a number of features:

- Has specific properties;
- Acts as a unit;
- Is dynamic;
- Acts as a closed system;
- Possesses the character of a self-regulating system;
- Is a managed system. (Faure, 2013)

The system can not include other entities that work in the market and are subject to other goals. Specificity of the banking system is determined by its elements and the relationships that develop between them. The essence of the banking system affects the composition and essence of its elements.

The banking system is a variety of parts subordinated to a single whole. This means that individual banks are connected in such a way that they can replace each other if necessary. The system is in motion, supplemented with new components, is being improved. New connections are constantly arising within the system. The banking system is closed to the extent that it must comply with banking secrecy. Self-regulation of the system means that it is influenced by changes in the economic conjuncture, political situation. The system is manageable, since the central bank conducts an independent monetary policy, in various forms is accountable only to the parliament or to the executive branch. The activities of commercial banks (business banks) are governed by general and special banking legislation, economic regulations. The supervision of the activities of commercial banks by the central bank or other specialized state bodies is functioning. (Training, 2016)

The banking system directs funds from creditors to borrowers, financial intermediaries issue their own debt obligations (banks - deposits, insurance companies - annuities), sell them in the money market, and the proceeds are purchased by foreign debt obligations. This process of creating obligations and exchanging them for the obligations of other counterparties, i.e. Double exchange, is the essence of financial intermediation. The most important function of financial intermediaries is that they bring their assets and liabilities in line with consumers' requests, regulating the coincidence of the interests of savers and borrowers (liabilities are formed taking into account the wishes of investors to invest their money in a particular financial instrument, and placement into assets is carried out Based on the needs of borrowers to obtain loans). Bank intermediaries receive economies of scale as lenders and borrowers, reduce their risks and unit costs due to the size of their portfolios and the use of techniques for their diversification. (Song, 2000)

The way of payments to be performed through the banks correspondent the following scheme:

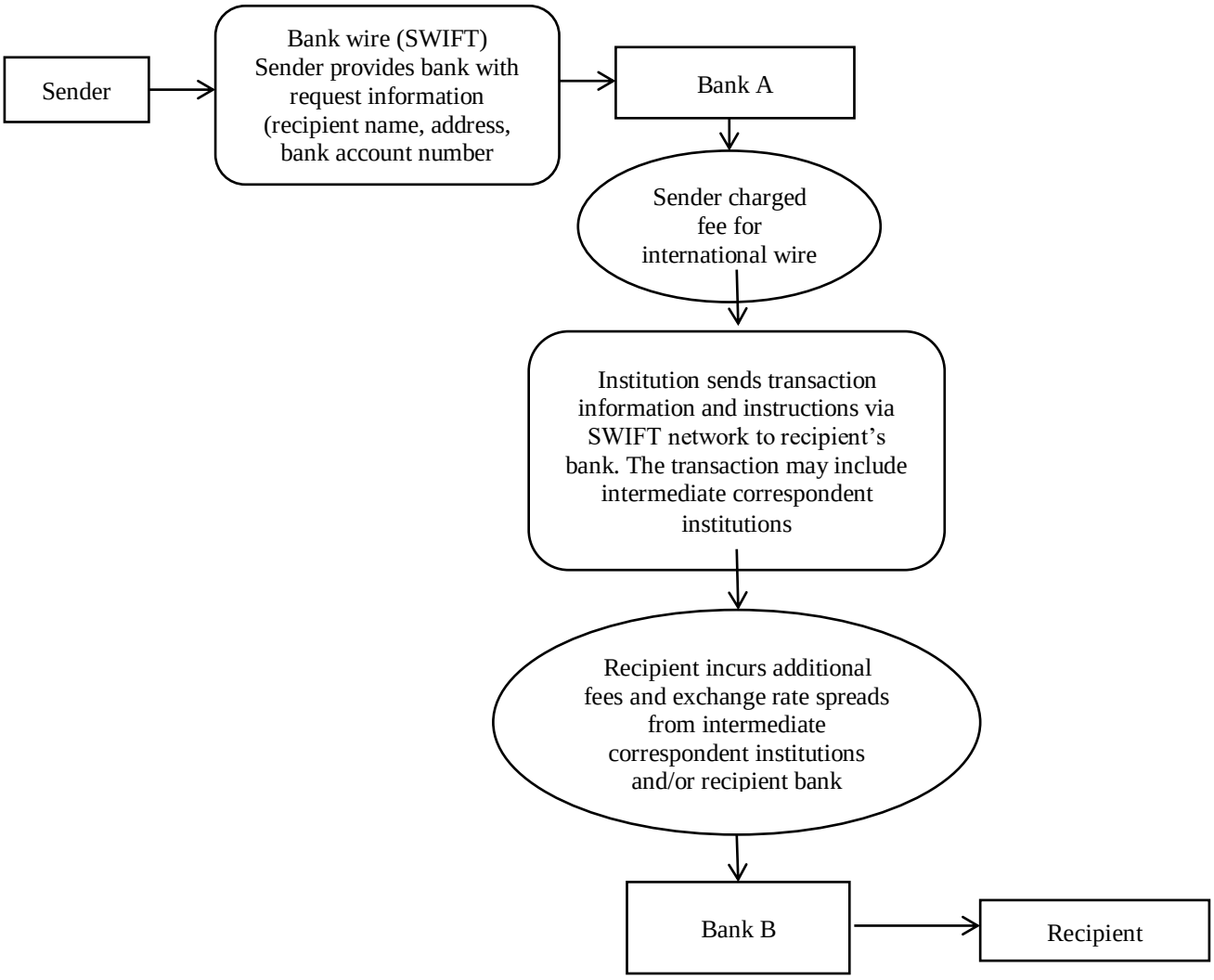


Figure 3. International bank transaction scheme

2.1 Payment system

In monetary systems, where the functions of money as a medium of circulation and means of payment carry out full-value metal coins and the problems of creating and regulating the payment system do not arise. Transfer of full-value money from the seller to the buyer, from the creditor to the debtor means the fact of the final payment and repayment of the debt. When using paper and credit money, there is a need to develop special rules for their handling and transfer procedures, which should ensure that all participants in the calculations clearly understand the fact of making a payment and repaying the debt. A special system for transferring payment information is being formed.

The importance of these rules, procedures, and systems is significantly increased when switching to the use of non-cash payments and electronic money. In each country, an independent payment system is created within the financial system. With the development of international exchange, there are international payment systems that ensure payments between participants in international markets, located in different countries.

The payment system is a set of rules, contractual relations, technologies, calculation methods, internal and external regulations that allow all participants to make financial transactions and settlements with each other. Consider, according to this definition, every component of the payment system. From the position of systemic, all the elements of the latter must be in interaction, only in this case the effectiveness of its functioning can be achieved.

The efficiency of the payment system is the timeliness and reliability of the transfer and accounting of payment resources allocated for payments. With effective functioning of the payment system, transaction costs are significantly reduced, there is an opportunity for better liquidity management in both banks and enterprises. Various failures, unintended or unexpected delays in payments significantly undermine confidence in the payment system, economic agents are beginning to doubt whether payments will be made at all. All this leads to an increase in the risk, and thereby both the increase in the costs of participants in the payment system and the payment crisis. This is clearly demonstrated by the crises of 1994 and 1998. In Russia, when non-payments of customers entailed non-payments of commercial banks.

The main function of any payment system is to ensure the dynamics and sustainability of economic turnover. The presence of an effective payment system facilitates the monitoring of the monetary sphere, helps banks actively manage liquidity, thereby reducing the need for large and excessive reserves. As a result, the process of drawing up a monetary program is simplified and financial operations are accelerated.

Elements of the payment system. Those are the following:

• Institutions providing services for making money transfers and repaying debt obligations;

• Financial instruments and communication systems that ensure the transfer of funds between economic agents;

• Contractual agreements regulating the order of non-cash settlements.

The main participants of the payment system are the central bank, commercial banks, non-banking institutions, including clearing and settlement centers. They act as institutions that provide services for the implementation of money transfers and the repayment of debt obligations. Ensuring the continuity of payments is assigned directly to the central bank of the state. The work of the payment system is closely connected with the realization of the main objective of the central bank's activity - ensuring the stability of the banking system. In this case, the central bank can act as:

• The user of the payment system, i.e., carry out his own operations;

• A participant in the payment system, ie, make or receive payments on behalf of its customers;

• The person providing payment services;

• Defender of state interests, the one who performs the function of the "regulator" of the payment system, overseeing its participants and establishing general rules for their operation.

2.2 Payment system principles

The basic principles of building payment systems are determined by the Committee on Payment Systems, which operates within the framework of the Basel Committee on Banking Supervision. They are applicable to all payment systems of different states and are as follows:

• The system should have a well-developed legal framework in all relevant jurisdictions;

• The rules and procedures of the system should give participants a clear idea of its impact on each of the financial risks they incur due to participation in the system;

• The system should have well-defined procedures for managing credit and liquid risks, establishing the appropriate liability of the operator of the system and its participants and containing appropriate incentives for managing and deterring these risks;

• The system should provide a quick final settlement on the value date, preferably during the day or at the extreme end of the day;

• The system in which multilateral netting is conducted should at least be able to ensure the timely completion of daily settlements in the event that the participant with the largest individual settlement obligation is unable to settle;

• The system must have a high degree of security and operational reliability and have spare procedures for the timely completion of data processing for the day;

• The means of payment offered by the system should be practical for users and effective for the economy;

• The system should have objective and publicly announced criteria for participation in it, ensuring fair and open access;

• The system management procedures should be effective, accountable and transparent.

In addition, the Committee on Payment Systems defines the role of central banks in the state payment system and their tasks in accordance with the basic principles:

1. The central bank should clearly define its objectives and promulgate the main policy directions in relation to meaningful payment systems

2. The central bank should ensure compliance with the basic principles of the systems it manages;

3. The central bank should supervise the observance of basic principles by systems that it does not manage and have the opportunity to do so;

4. To ensure the security and efficiency of payment systems through basic principles, the central bank should cooperate with central banks of other states and any relevant national or foreign institutions.

2.3 Types of payment systems

In order to determine the characteristic models used in money transfer systems, it is necessary to distinguish the main differences between them, for example, such as:

• The system operator (central bank or private organization);

• A settlement mechanism (gross or net settlement);

• A credit facility (with or without credit to the participant of his settlements during the working day).

For a more detailed consideration of these concepts, let us turn to the classification of payment systems. In fig 3 is shown the classification of payment systems for various features.

By hierarchy, or degree of subordination, the systems are centralized, where each group of participants of the lowest level establishes a relationship with one of the participants at the highest level, and the latter are subordinate to a single center, and decentralized, where individual links between participants can be formed independently of all others. The centralized system includes the Bank of Russia settlement system, and the decentralized system of interbank settlements through the establishment of direct correspondent relations between credit institutions, the clearing system of interbank settlements, and the intra-bank settlement system.

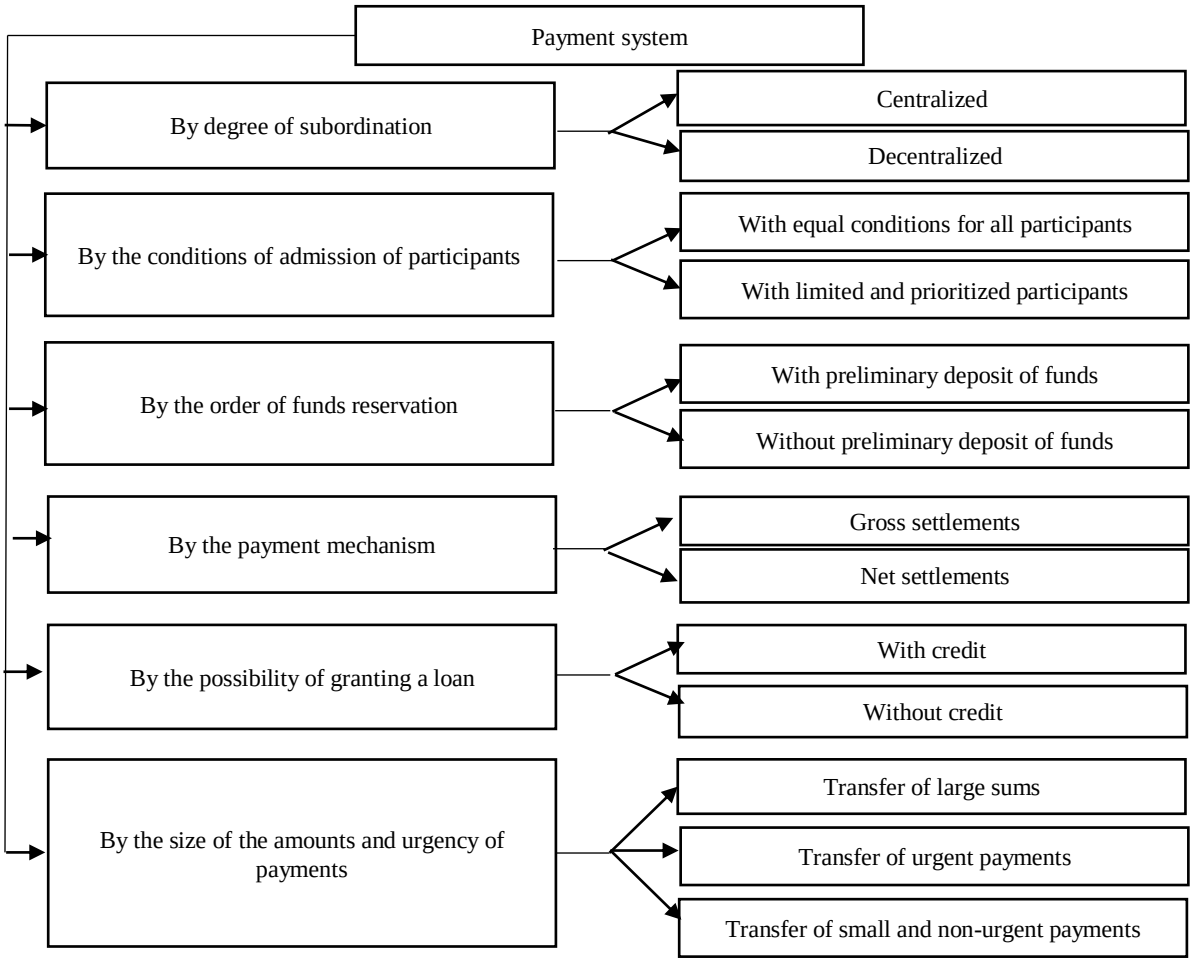


Figure 4. Payement system classification

The payment system of the Bank of Russia is centralized. (Fig. 5).

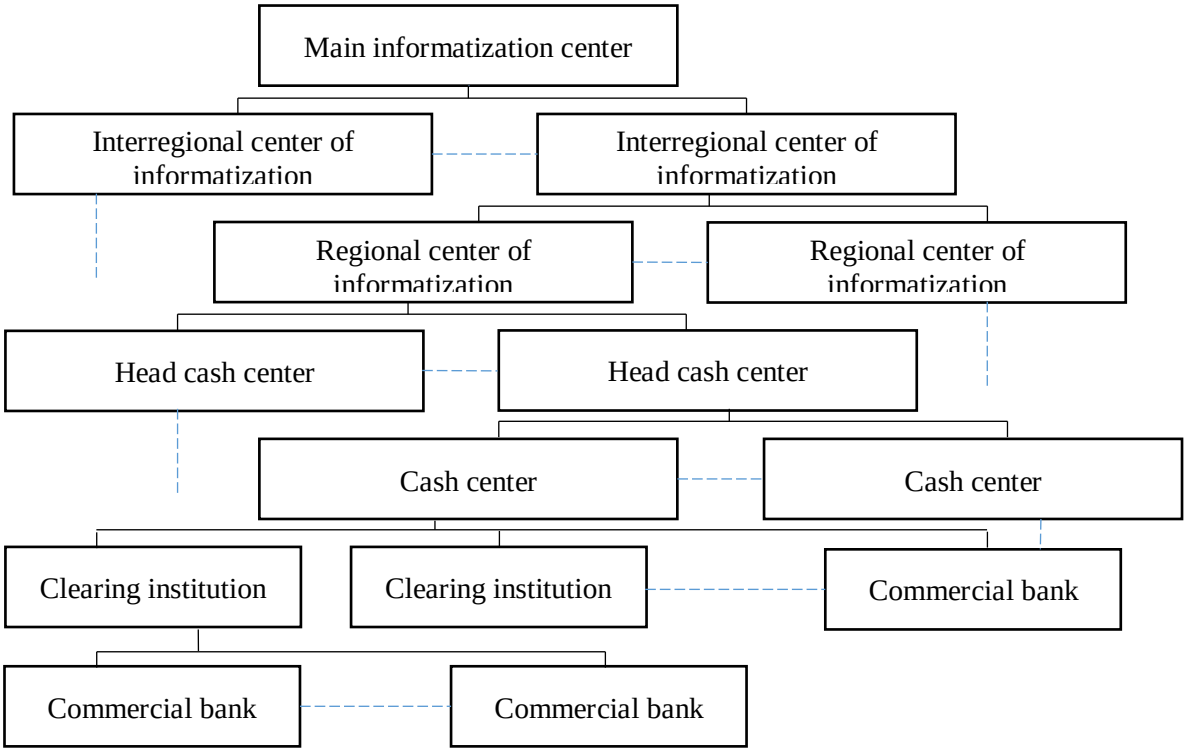


Figure 5. Centralized intra-bank payment system structure

Intra-bank settlements also take place in a centralized system when they are implemented between the branches of the settlement network, as well as at the regional and interregional levels. Considering all existing systems in Russia, it should be noted that only the clearing system is based on net calculations.

Different payment technologies can be used in payment systems. First, there are technologies based on paper carriers. They are used both in centralized and decentralized systems of interbank settlements. Secondly, there are electronic calculations. The central bank of the Russian Federation brings commercial banks to transition to the electronic form of payments, increasing tariffs for transactions based on paper technology.

With direct correspondent relations between banks, for the majority of settlement operations, technologies based on electronic settlements are used, using all possible means of banking communications. At present, the following types of payment instruments are used by economic bodies: payment orders, instructions, letters of credit, checks and bills. The prevailing form of payment is payment orders.

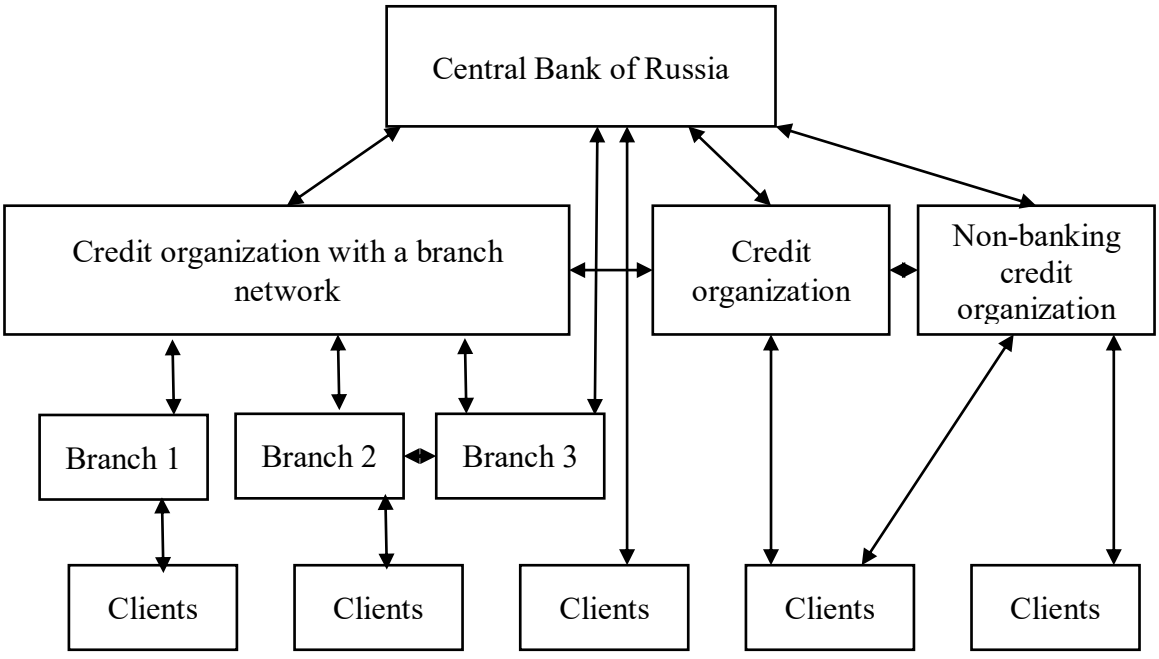


Figure 6. The structure of payment system in Russia

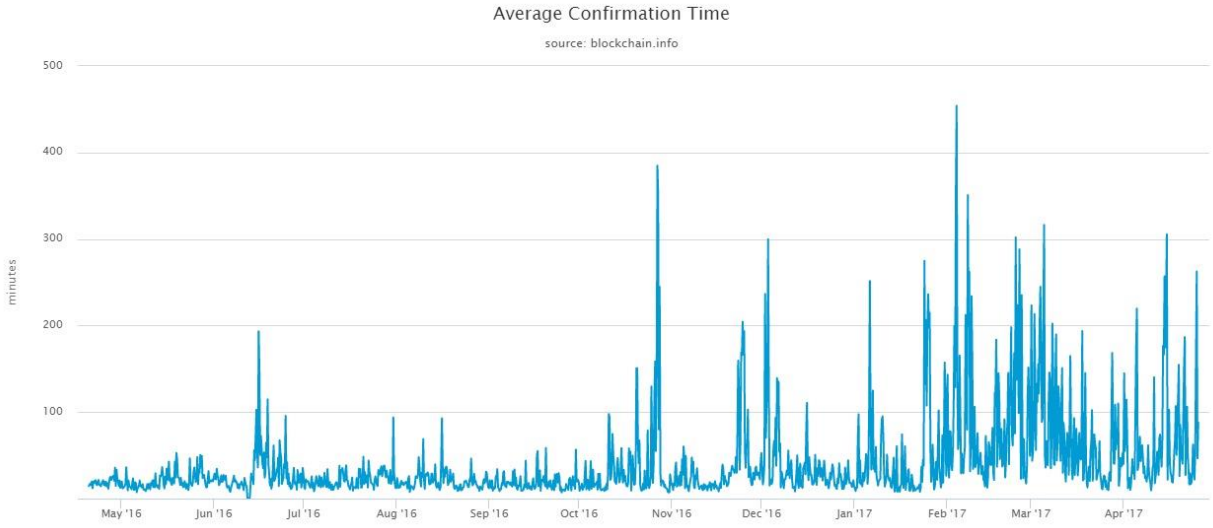
The settlement system through the Bank of Russia settlement network is currently predominant in our country, however, only national currency can be settled through it. Therefore, all operations related to settlements in foreign currency are made through a decentralized system of interbank settlements, mainly through direct correspondent accounts of credit institutions. For this, as a rule, an electronic method is used, which allows commercial banks to speed up the calculations among themselves. Commercial banks on the basis of direct correspondent relations can also carry out interstate settlements through accounts opened in commercial banks of the

respective states. Such a right is granted to banks that have received a general or extended license.

2.4 Traditional banking system and decentralized payment system comparison

The comparison would be performed step by step. Let's discuss the advantages of the decentralized system first.

- Availability 24/7/365. According to blockchain.info web-site the average time for transaction to be confirmed is around 60 minutes. On the picture 1 you can see the graph of average daily time for confirmation of transaction through last 2 years. The maximum value is 465 minutes. But after analyzing the graph it is possible to conclude that this value is unusually high. What is more, unlike to the traditional banking system the payment could be performed any time the agent would like. That brings much more flexibility to the payment opportunities of the blockchain system; (Kelly, 2015)



Picture 6. Average time for transaction confirmation

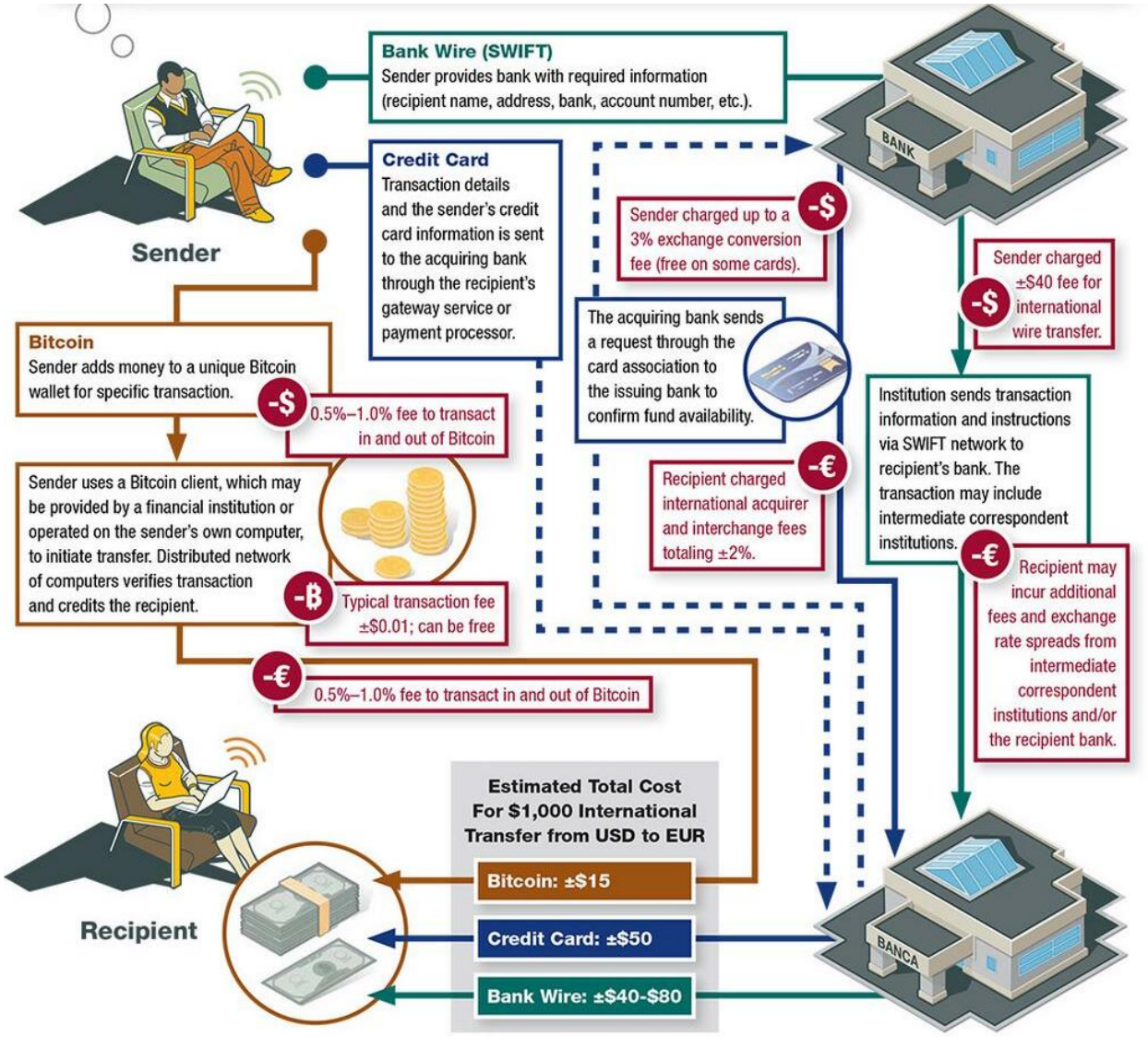
- Antifraud. The use of blockchain could reduce the need for independent auditors and in-house accountants and lawyers to identify fraud and recover damages resulting from it;
- No intermediary party;
- Possibility of applying of smart-contracts. Smart contract is a term used to describe computer program code that is capable of facilitating, executing, and enforcing the negotiation or performance of an agreement (i.e. contract) using blockchain technology. The entire process is automated can act as a complement, or substitute, for legal contracts, where the terms of the smart contract are recorded in a computer language as a set of instructions;

- Transparency. It is possible to look after any unit which was moved through the blockchain system and check its “history” (path) from very beginning at any moment of time;
- Zero commissions. As it was mentioned before there is no intermediary, blockchain is a p2p decentralized system. Perform a transaction through a blockchain system is like to give a cash from hands to hands;
- Safety, reliability, secure;
- Easy to start and open source;
- Full control under your own funds;

  From the other hand decentralized system has its own disadvatages which are by the traditional system advantages:
- The legal status. As it was mentioned in the part 1.10 the legal status of the cryptocurrency usage is absolutely different in different countries. What is more it is hard to predict changes in this field across the world.
- Decentralized system needs huge amount of information to work. To maintain the system working it is obligated to store all the chain which includes the history of all transactions done. Today this database is around 200GB and it is always growing;
- Increased competence requirements for all workers in that field;
- Traditional system is less financially risky;
- Decentralized system doesn’t provide any service except payments (Karame, 2016)

There is a big differences in performing payments through a bank or through a blockchain. First of all these difference could be analyze from the costs point of view. As it was mentioned before costs on transactions are absolutely different. Bank charges the money sender for its service and if the payment is international for currency exchange as well. In the blockchain way of performing payments the only thing that user could be charged for is buying cryptocurrencies on the exchange. The good way of methods comparison is the creating of a scheme of payment of both way and analyzing costs on each step of a treansaction.

Let’s suppose a U.S. citizen wanted to rent a vacation house in Europe. The following diagram compares some alternatives methods by which a 1000$ down payment could be sent. Even at this early stage in Bitcon’s development the total monetary cost to the sender and recipient of transacting using bitcoin compares favorably to more traditional alternatives. The diagram also shows the potential for the sender to transmit bitcoins to the recipient without use of an intermediate financial institution. (Short, 2016)



Picture 7. Bitcoin VS traditional payment

According to the calculations on the scheme above the most profitable way in the case concerned of transaction performing is the blockchain technology. The approximate costs on the international 1000$ payement are:

Method	Cost amount on 1000$ transaction	Cause of a cost
Bitcoin payment	+-15$	On buying bitcoin at exchange
Credit card payment	+-50$	Interchange fees, international acquirer fee, exchange conversion fee
Bank wire	+-40-80$	International wire transfer fee, additional fees and exchange rate spreads

Table 1. Different payment methods costs

To sum up the Chapter 2 it is necessary to mark that this chapter shows the theory about the banking system. The history, types and some details about banks. As in the first chapter the scheme of payment process was created and compared with the decentralized one. On that comparison did not stop: the results of analysis of bank system structure gave the opportunity to compare it with the decentralized payment system. This comparison was made both in qualitative and quantitative ways. First the advantages and disadvantages were discussed and then the example with cost calculation was made.

As a conclusion it should be stated that both systems has their own pros and cons and they are not going to replace themselves: they provide great addition to each other. Blockchain payments have smaller costs but they are not applicable in every case.

Chapter 3. Ahlers case

3.1 About the company

Ahlers AG is Belgium logistics company. Ahlers offers services in five areas: international forwarding, maritime services, project logistics, agency work, warehousing and value added services. With 35 offices on 3 continents Ahlers provide experienced logistics experts all around the world. Ahlers have expertise in the steel, tobacco, oil and gas, chemicals and consumer goods industries.

Ahlers has an annual turnover of $205 million and employs 950 staff, plus about 350 sea farers for crewing within its maritime services. Ahlers has experienced professionals, proven systems, and follow industry best practices to design the logistics solutions that make their clients successful.

The scope of this research is focused on the Russian branch of the company, more specifically, to three legal entities, which are established in Saint-Petersburg Metropolitan Area: CJSC Astros, RusImport LLC, and CJSC Ahlers. (Ahlers, 2017)

Ahlers in Russia

Ahlers in Russia consists of seven legal entities. Certain functions of the company are allocated to different legal entities in order to isolate risk. Ahlers Rus (joint stock company) is the management body of Ahlers in Russia and carries the management functions: management, sales, human resources and finance. Astros LC (joint stock company) is the owner of fixed asset, which is mainly warehouse. Astros LC is in charge of warehouse maintenance and warehouse security. Ahlers Customs (limited liability company) provides customs services and possesses customs license and labor contracts. Ahlers TL (limited liability company) is a new legal entity and provides forwarding services. A.C. Distribution (limited liability company) deals with storage and cargo handling. This entity owns and rents some equipment. Rusimport (limited liability company) focuses on trading activities and legally owns the imported goods.

Entity Name	Function	Detail
Ahlers Rus	Management	Finance Department, Sales Department, Human Resources Department, and etc
Astros LC	Holding Property	No contract with clients Warehouse maintenance and security
Ahlers Customs	Customs services	Custom license Labor contracts

Ahlers TL	Forwarding services	No assets Labor contracts
A.C. Distribution	Storage &Handling	Own/rented equipment Labor contracts
Rusimport	Trading	Trading activities

Table 2. Ahlers entities in Russia

Ahlers in Russia carries four types of business: contract logistics, international forwarding, project cargo, and custom clearance & trade logistics.

Contract logistics refers to outsourcing of recourses management to a third party. Ahlers as a contract logistics companies handles activities such as designing, planning and optimizing supply chains, warehousing, transporting and distributing goods, processing orders and collecting payments, managing inventory and even providing certain aspects of customer service.

For international forwarding, Ahlers acts as a third party logistic provider to arrange air freight, sea freight, railway freight, and truck freight. Ahlers can provide flexible delivery terms, optimizing transportation route and provide guarding service for valuable cargo. International freight besides transportation also includes the organization of customs clearance, storage and other related services.

Project cargo is a term used to broadly describe the national or international transportation of large, heavy, high value pieces of equipment. Ahlers has rich experience dealing with project cargo. It maintains a dedicated project logistics team to provide a customized solution for client's project cargo and execute the shipment.

Trade logistics together with custom clearance is a service targeting at international clients who want to export and sell goods on Russian market. When a Russian customer requests a DDP (Delivered Duty Paid), it means that he wants to buy custom cleared and imported goods. Since tax representation is not possible in Russia, international sellers cannot trade directly with Russian customers. (Doorslaer)

Rusimport is born for solving this issue. As a Russian legal entity, Rusimport can import and re-sell/deliver the goods in Russia on DDP terms. International clients sell the goods to Rusimport and get the payment from Rusimport after agreement with their customers in Russia. Rusimport then imports the goods, resells to customers in Russia and gets paid according to the already established agreement. By selling goods to Rusimport, the client outsourced customs clearance and import, local logistics transporting, warehousing, distribution and payment collection to Ahlers. Under trade logistics business, Ahlers acts as both a dealer and a third party logistics provider.

Core Competence

Warehouse. Ahlers's core competences as a contract logistics company lies in self owned high standard warehouses, and self developed IT system. Ahlers has Class A Warehouse in Saint Petersburg and Class B+ warehouse in Chelyabinsk. Its Class A Warehouse has total site surface of 200,000 m² and covered storage area of 44,000 m². All warehouses can maintain temperature at 15 degree Celsius.

STORE Warehouse Management System combines user-friendly interfaces with sophisticated RF tracking and in-depth reporting. STORE © makes it easier to maintain precise tabs for client inventory and inventory changes. The system can also be seamlessly connected to the customer's existing ERP system. (Christopher, 2011)

Track & Trace System. The Ahlers track & trace system provides accurate, real-time information about the progress of the goods. Track & trace system means more than just passive tracking. Ahlers together with clients use this information to predict risk and intervene when needed.

Ahlers uses advanced IT systems to reduce most of the administrative burden. Its fully automated online booking platform links with client's ERP package and integrates the entire documentation process. The IT systems can automate most backend management.

Tobacco Logistic. Tobacco and related products are stored and handled by Ahlers Logistics in several countries in the CIS region. This includes all sorts of products: tobacco, cigarettes, and production materials as well as marketing materials. Ahlers anticipated the latest trends and set up a truly dedicated tobacco team that specializes in industry-specific requirements. Today, Ahlers offers supply chain solutions to the top three of the tobacco industry.

Ahlers develops sophisticated software-based alternatives for valuable cargo, especially the tobacco industry, and offers a good advantage over competitors at a cost of 50% of traditional guards. Ahlers' Cargo Security Solution (alarm, remote monitoring and tracking system) can be implemented easily, quickly and reliably in all cargo transportation systems. Ahler's emergency intervention team supports it 24 hours a day. (Marketline, 2017)

Ahlers in the industry

Transportation and logistics service industry consist of three segments: freight transportation, warehousing services, and 3PLs. Ahlers operates in both warehousing service sector segment and 3PLs segments.

As a third party logistics provider, Ahlers serves end customers who consume logistic service buy using asset-based providers as suppliers. 3PLs not only act as an intermediary

between end customers and asset-based providers forwarding the shipment from end customers to asset-based providers but also working on supply chain management and providing solutions to end customers. Common benefits of using 3PLs identified by end customers are reduced logistics cost and improved logistics effectiveness. The recent trend shows that 3PLs engaging deeper into customer's supply chain and become strategic partners with customers.

3PLs' key competence lies in technologies and know-how. According to survey carried by Capgemini Consulting (2016), Warehouse / DC management, Transportation management (Planning), Visibility, Transportation management (Scheduling), and Electronic data interchange (EDI) are top five tools a 3PL needed to be successful. Key players in Russian 3PL segment are western logistics providers such as P&O Trans European, FM Logistic, Kuhne+Nagel, Welz, DB Schenker, Panalpina. They have wide experience, technological advance, and a wide international customer base. (Rushton, 2014)

It is common for a 3PL to vertically integrate back with asset based provider business in the transportation industry. Ahlers is also an asset based provide who owns three warehouses in Russia and offers warehousing service. Many global 3PL companies have self-owned warehouse and facilities. DHL Supply Chain & Global Forwarding owns air cargo fleet and vehicles. DB Schenker Logistics is operating in rail freight and road freight business. 3PL operators having warehouses is also common in Russia. Itella owns warehouses in seven Russian cities adding up to more than 500000 square meters. Other examples are STS logistics, Alidi, Beelogistic, and Srednevolzhskaya Logistics Company. Their business model is similar with Ahlers where they use self-owned warehouses as terminals for customer's cargo. The combination of 3PL and warehouse service provider makes Ahlers closer to end customers and more sensitive to buyers power in porter's five forces analysis. (Marketline, 2017)

3.2 Ahlers Case

In 2016, the company noticed that banking transaction costs for these three entities have increased by 73% in comparison with the previous year. One of the cost drivers are the costs which company take because of the intercompany transactions. Branches are always in need to transfer money between themselves. As it was mentioned before, Ahlers is specializing on logistics and it suggests to their costumers the creation of the whole supply chain for their needs.

Most of their clients produce and sell their products not only in different countries but in different parts of the world. Because of this all of the branches are in close cooperation. Along with the whole supply chain different branches are working on the success of the project and consequently all of the branches have payables and receivables between them. According the rules of the company all the payables are paid back in the beginning of the next year. All of the

transactions are performed by the traditional system – with banks as intermediaries. This provides transactional costs: commissions, currency exchanges, payments for bank services.

3.3 Value at Risk

In its most general form, the Value at Risk measures the potential loss in value of a risky asset or portfolio over a defined period for a given confidence interval. Thus, if the VaR on an asset is $ 100 million at a one-week, 95% confidence level, there is a only a 5% chance that the value of the asset will drop more than $ 100 million over any given week. In its adapted form, the measure is sometimes defined more narrowly as the possible loss in value from "normal market risk" as opposed to all risk, requiring that we draw distinctions between normal and abnormal risk as well as between market and nonmarket risk. While Value at Risk can be used by any entity to measure its risk exposure, it is used most often by commercial and investment banks to capture the potential loss in value of their traded portfolios from adverse market movements over a specified period. This can then be compared to their available capital and cash reserves to ensure that the losses can be covered without putting the firms at risk. (Jorion, 2006)

There are three key elements of VaR – a specified level of loss in value, a fixed time period over which risk is assessed and a confidence interval. The VaR can be specified for an individual asset, a portfolio of assets or for an entire firm. While the VaR at investment banks is specified in terms of market risks – interest rate changes, equity market volatility and economic growth – there is no reason why the risks cannot be defined more broadly or narrowly in specific contexts. Thus, we could compute the VaR for a large investment project for a firm in terms of competitive and firm-specific risks and the VaR for a gold mining company in terms of gold price risk. In the sections that follow, we will begin by looking at the history of the development of this measure, ways in which the VaR can be computed, limitations of and variations on the basic measures and how VaR fits into the broader spectrum of risk assessment approaches.

For this research VAR methodology could be applied for measuring the risk of having cryptocurrency on balance and the following compare of that risk with the savings on banking costs. To calculate VaR the return rates on the bitcoin would be calculated. (Bo, 2001)

Suppose the current price of a bitcoin is P_0 and the rate of return for this currency is normally distributed with mean μ and standard deviation σ. Then the value at the end of the time horizon is $P_1 = P_0(1 + R)$ with mean $P_0(1 + \mu)$ and standard deviation $P_0\sigma$. The next one important parameter is $\propto$, which stands for the cut of tail with the chosen confidence level. For example, if $c = 95\%$ the corresponding $\propto$ is 1,65 and if $c = 99\%$ the $\propto = 2{,}33$. Since the VaR corresponds to the left tail, the actual cut of line $-\propto$ as illustrated in the following graph. (Hull, 2014)

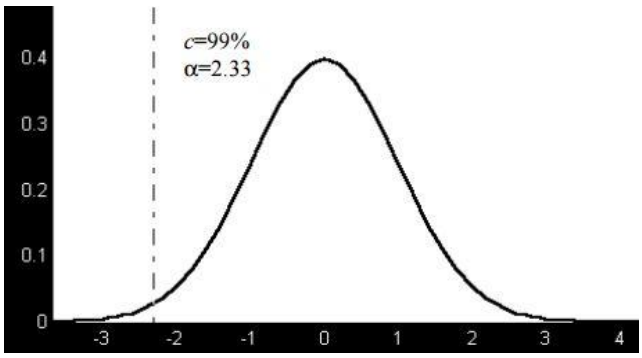


Figure 3. The standard normal curve with c=99%

Firstly, we denote the lowest cryptocurrency value at some confidence level c as the following: $P_1^* = P_0^*(1 + R^*)$. Then VaR number relative to the expected return is $VaR(mean) = E[P_1] - P_1^* = P_0(1 + \mu) - P_0(1 + R^*) = P_0(\mu - R^*)$. Assuming the expected return is 0, $VaR(0) = -(P_1^* - P_0) = -P_0(R^*)$. (Jorion, 2006)

As long as the $R^* = -(\propto \sigma - \mu)$, where $\propto$ corresponding to the confidence level c n the normal distribution, we get the following:

$$VaR(0) = P_0(\propto \sigma - \mu); \quad (1.1)$$

$$VaR(mean) = P_0(\propto \sigma) \quad (1.2)$$

3.4 Case data

As it was mentioned before different offices of Ahlers company usually cooperate. This cooperation is caused by the hard process of supply chain creation. From one hand not only one office works on one particular project and from the other hand costumer pays to the initial one. As a result all offices have receivables and payables in front of each other.

AhlersRus provided the information about its mutual settlements with the main colleagues: receivables and payables accounts with reconciliation acts for the last quarter of 2016 year. Below you can see the example of the reconciliation table between AlhersRus and Ahlers Belgium which is the company's head office and the total table with mutual settlements. All other reconciliation acts are in the appendix.

Transaction currency	Profit-and-loss account		Balance 31/12/2016		Explanation
	Cost	Income	In our favour	In your favour	
EUR		162 238,19			Operational income
EUR			18 764,64		Reseivable
EUR	555 735,90				Operational costs
EUR				64 000,00	Payable
USD		1299,50			Operational income

USD	786,00				Operational costs

Table 3. Reconciliation act with Ahlers Belgium

The following table contains total amount of receivables and payables around the AhlersRus of its colleagues. All the figures are in EUR.

Company	Receivables from the company	Payables to the company	Currency	Exchange rate
Ahlers India	0	8056.58	USD/RUB	57.16
Ahlers KZ	0	58 883.71	EUR/RUB	62.09
Ahlers TL	28 531	0	USD/EUR	0.915
Ahlers UKR	89 675.30	0	EUR/USD	1.0923
Ahlers Belgium	18 764	64 000		
Astros	951.21	1 117 942		
Klaipeda	63 236.86	0		
RusImport	86 862.53	0		
AhlersPlus	528.36	94 675		
Total	288 549.25	1 343 557		

Table 4. Total receivables and payables to other companies of AhlersRus

Banking costs

Russian office of the Ahlers company is serviced by the Raiffeisen bank. In 2014 year a contract was signed and those conditions are still actual. According to the agreement between the company and the bank, Raiffeisen charges the following fees for international transactions:

Outcoming transfers in the other currency	0,1% of transcation
Commission for transaction	0,5% of trnasaction

Table 5. Bank tariffs for AhlersRus

According to the rules of the Ahlers company all the payables should be paid back during the quarter. Because of this we can calculate how much AhlersRus lost on transactional costs for paying back its debt in the last quarter of the 2016 year.

It should be noticed that all the data needed is represented in the table 3, but not all the transactions should be charged for 0,1% commission. For instance, AhlersRus pays to Astros in rubles. (Madisetti, 2017)

According to bank tariffs and data provided the total loss of AhlersRus on transactions for paying back the debt would be:

$$1\,343\,557 * 0{,}5\% + (8056.58 + 58883.71 + 64000 + 94675) * 0{,}1\% = 6943.40$$

This figure means that AhlersRus lost on banking costs 6943.40 EUR for paying back its debt.

Banking costs which were taken by other entities for paying back their payables are calculated in the following table. We can assume that colleagues of Ahlers are using pretty simmilar banking tariffs.

Company	To pay	Costs
Ahlers India	0	0
Ahlers KZ	0	0
Ahlers TL	28 531	171.19
Ahlers UKR	89 675.30	538.05
Ahlers Belgium	18 764	112.6
Astros	951.21	4.76
Klaipeda	63 236.86	379.42
RusImport	86 862.53	434.31
AhlersPlus	528.36	3.17
Total		1643.48

Table 6. Banking costs of other entities to pay back the loan to AhlersRus

After analyzing these tables it is possible to conclude that the calculated number of costs which is lost because of the money transfers around the AhelrsRus (In case when AhlersRus pays back it's debt and other offices pay their payables to it) is 1643,48+6943=8586,48 per quarter.

In the direct cooperation with AhlersRus there are 11 companies but the whole corporation consist of much bigger amount of entities. That means that the Ahlers Corporation losses on the banking costs much more than the calculated amount.

Switching to cryptocurrencies. Buying bitcoins on exchange

As it was shown in the first part of this paper there are different ways of getting bitcoin. Not only mining but buying cryptocurrencies on online exchanges is a great opportunity. What is more it is possible to start to earn in bitcoins – company can sell their goods and services for bitcoin. Let's get into it step by step.

Buying bitcoins on the online exchange. There are a lot of different exchanges where anybody can buy or sell cryptocurrencies. For the further analysis the Poloniex.com exchange was taken as it has the highest safety levels and credit ratings.

Poloniex.com commission for exchange of the currencies are in the table above (Poloniex, 2017)

Maker	Taker	Trade Volume
0.15%	0.25%	<600 BTC
0.14%	0.24%	>= 600 BTC
0.12%	0.22%	>= 1200 BTC
0.1%	0.2%	>= 2400 BTC
0.08%	0.16%	>= 6000 BTC
0.05%	0.14%	>= 12 000 BTC
0.02%	0.12%	>= 18 000 BTC
0.00%	0.1%	>= 24 000 BTC
0.00%	0.08%	>= 60 000 BTC
0.00%	0.05%	>= 120 000 BTC

Table 7. Poloniex.com prices for convertation

Every trade occurs between two parties: the maker, whose order exists on the order book prior to the trade, and the taker, who places the order that matches (or "takes") the maker's order. Makers are so named because their orders make the liquidity in a market. Takers are the ones who remove this liquidity by matching makers' orders with their own.

The maker-taker model encourages market liquidity by rewarding the makers of that liquidity with a fee discount. It also results in a tighter market spread due to the increased incentive for makers to outbid each other. The higher fee that the taker pays is usually offset by the better prices this tighter spread provides.

The total debt of AhlersRus company to be paid back is 1 343 557 EUR which would provide 6 943,40 EUR of banking costs.

If company buys bitcoins on 1 343 557 EUR the maximum amount they can loose on commission is 2015.34 EUR and the minimum one is 0. This amount depends on the bitcoin exchange rate. On the 16.05.2017 this rate is 1668,12 USD per bitcoin so if the company would buy cryptocurrency now they were to pay commission of 0,16% and it would be 2 149,69 EUR.

Potential savings for AhlersRus could be 6943.40-2149.69=4793.71 EUR per quarter.

From the other hand risks of having bitcoins on balance should not be forgotten. To understand how much bitcoins should be bought and used as a payment method with a minimal risk the value at risk analysis is applicable.

Calculating VaR

After performing the transaction to counteragent there are 2 alternatives: company can save bitcoins and use it further or change to fiat currency like USD or EUR. Having bitcoin as an asset in a long-term opportunity is a great idea. It is a good approach to diversify risk. What is more bitcoin rate has a positive trend and the most of researchers believe that it is going to grow infinite because the demand on the bitcoin is growing very fast, but the emission is going to stop anyway.

To solve the case problem the best approach is to calculate all the data needed and results for the last quarter. In the following table there are daily prices (BTC/EUR) and returns of the Bitcoin for the year ending in the last day of the last quarter of 2016.

Date	Price	Daily return
30.12.2015	425.56	
31.12.2015	429.94	-1%
….	….	….
29.12.2016	971.99	-1%
30.12.2016	963.36	-1%

Table 8.Bbitcoin historical rates and daily returns

To find the daily returns logarithms were used. Using logarithms provides the log-normal distribution of the returns: $R_t = \ln(\frac{P_t}{P_{t-1}})$.

The mean of returns equals to $\mu = 0.2232\%$; deviation $\sigma = 2{,}51\%$; Quintile with 10% confidence level is -0,02994.

VaR for the following day is 934$. With probability of 90% Bitcoin price won't be lower than 934 in 1 day. VAR for the following 90 days (the next quarter, the first of 2017) is 689$, so with probability 90% bitcoin price won't be lower than 689$ in 90 days.

	%	Absolute value
VAR(t+1)	-3%	934,25
VAR(t+90)	-33%	682,75

Table 9. VaR calculation results

3.5 Problem solution in general form

To understand and formalize the company's strategy of banking costs reduction with the blockchain technology the problem should be solved in the general form. Let's introduce some variables:

- P – Company's total payables;

- R – Company's total receivables;
- C_{b1} – Commission of the bank for the transaction;
- C_{b2} – Commission of the bank for the transaction made in the other currency;
- C_{BTC} – Commission for buying Bitcoins on the exchange;
- $r_{t;btc/usd}$ – Bitcoin/USD exchange rate at the day t

To go on with this problem first of all the total bank commission (TBC) and bank commission on payables (PBC) for performing all of the transactions should be calculated:

$$PBC = P(C_{b1} + C_{b2}) \tag{1.3}$$

$$TBC = P(C_{b1} + C_{b2}) + R(C_{b1} + C_{b2}); \tag{1.4}$$

To understand how much bitcoins should the company buy on the exchange the VaR(t+1) is needed. The calculation should be performed in the next way:

$$BTC = \frac{PBC}{r_{t;btc/usd} - VaR(t+1)}; \tag{1.5}$$

In the denominator of fraction there is a difference between the day of the transaction performing and the VaR for the next day. This is the possible spread in the exchange rate within 2 days which shows that with the probability c the exchange rate won't fall down more than the difference in the denominator. As in the numerator of fraction stand banking costs, changes in bitcoin exchange rate won't provide any loss with the probability c – in the worst case, which corresponds to the probability $1 - c$ company's total savings as well as losses would be zero. In other words if bitcoin exchange rate would fall down on VaR amount (only with $1 - c\%$ probability) the losses won't exceed total amount of planned savings.

The calculated amount shows how much Bitcoins should be bought on the exchange. As it was mentioned in the first chapter the minimum amount of bitcoins which is possible to be used is 1 Satoshi or 0,00000001 BTC. If $\frac{PBC}{r_{t;btc/usd} - VaR(t+1)} < 0{,}0000001$ the company should not use this approach and perform all of their payments by traditional banking system.

To buy the BTC bitcoins on exchange company will need to pay the commission. According to our problem the USD commission would be the following: $BTC * r_{t;btc/usd} * C_{BTC}$.

To pay back the debt the company should divide total payables in 2 groups: one group would be paid back in bitcoins and all the remaining debt by the traditional banking system. Total commission for that operation would be the following:

$$\left(P - BTC * r_{t;btc/usd}\right)(C_{b1} + C_{b2}) + BTC * r_{t;btc/usd} * C_{BTC}; \tag{1.6}$$

As the company is trying to save banking costs the general principal to be followed is that total losses on the operation with bitcoins should be less than losses which are caused by the traditional approach. Or in the parametric terms:

$$\left(P - BTC * r_{t;btc/usd}\right)(C_{b1} + C_{b2}) + BTC * r_{t;btc/usd} * C_{BTC} < P(C_{b1} + C_{b2}); \quad (1.7)$$

Total savings (TS) on banking costs would be:

$$TS = P(C_{b1} + C_{b2}) - \left(P - BTC * r_{t;\frac{btc}{usd}}\right)(C_{b1} + C_{b2}) - BTC * r_{t;btc/usd} * C_{BTC}; \quad (1.8)$$

From that inequality we could show with which VaR value the application of the method would have any sense. Total savings should be more than a zero, so:

$$TS = P(C_{b1} + C_{b2}) - \left(P - BTC * r_{t;\frac{btc}{usd}}\right)(C_{b1} + C_{b2}) - BTC * r_{t;btc/usd} * C_{BTC}; \quad (1.9)$$

$$P(C_{b1} + C_{b2}) - \left(P - BTC * r_{t;\frac{btc}{usd}}\right)(C_{b1} + C_{b2}) - BTC * r_{t;btc/usd} * C_{BTC} > 0; \quad (1.10)$$

$$P(C_{b1} + C_{b2}) - \left(P - \frac{PBC}{r_{t;\frac{btc}{usd}} - VaR(t+1)} * r_{t;\frac{btc}{usd}}\right)(C_{b1} + C_{b2}) - \frac{PBC}{r_{t;btc/usd} - VaR(t+1)} * r_{t;btc/usd} * C_{BTC} > 0; \quad (1.11)$$

$$\frac{PBC * r_{t;btc/usd}}{r_{t;btc/usd} - VaR(t+1)}(C_{b1} + C_{b2} - C_{BTC}) > 0; \quad (1.12)$$

From all the mentioned before the next conclusions could be done. To blockchain application be profitable the following inequalities should be respected:

1. $VaR(t+1) < r_{t;btc/usd}$;
2. $C_{b1} + C_{b2} > C_{BTC}$;
3. $\frac{PBC}{r_{t;btc/usd} - VaR(t+1)} > 0{,}0000001$

Receivables strategy

From the suggested approach of blockchain application the strategy of receivables management should be analyzed. After receiving transactions in cryptocurrency from counteragents the branch should make a decision on what to do with the money. Basically company has 2 main alternatives: to store cryptocurrency on the account or to sell some amount on the exchange to get USD. To understand the proper ratio between cryptocurrency to store and to sell the $VaR(t+90)$ should be calculated. As it was said before the calculations are performed on the quarter basis. Branches pay back their debts in the last days of the quarter so 90 $VaR(t+90)$ would help to value the risk of storing cryptocurrency on the account for the following quarter.

Let's assume that company would receive $BTC_R = \frac{R}{r_{t;btc/usd}}$ bitcoins.

The difference in the exchange rate of bitcoin at the transaction day and the $VaR(t+90)$ characterizes the probable loss of the company on storing bitcoins on the account. Thus, company should store the following amount: $\frac{TS}{r_{t;btc/usd}-VaR(t+90)} = bitcoins\ to\ store$, or:

$$\frac{P(C_{b1}+C_{b2})-\left(P-BTC*r_{t;\frac{btc}{usd}}\right)(C_{b1}+C_{b2})-BTC*r_{t;btc/usd}*C_{BTC}}{r_{t;btc/usd}-VaR(t+90)} = BTC_{to\ store}; \quad (1.13)$$

Thus, with the probability c company won't loose more on the exchange rate than they are going to save on banking costs.

It is obvious that all other amount of bitcoins should be selled on the exchange rate. Amount to sell would be: $BTC_T - BTC_{to\ store} = BTC_{to\ sell}$.

3.6 AhlersRus strategy

By implementing to the company bitcoin payments the idea is to reduce banking costs. But using bitcoins brings an additional risk – the risk of exchange rate changes. As it was showed before the perfect strategy for Ahlers entities would be buying some amount of bitcoins and switch some amount of payments for cryptocurrencies. With the respect to the risk AhlersRus should use such an amount of cryptocurrencies which won't bring the risk of loss more than the possible savings on banking costs. Let's summarize all the data which we have in the following table:

Parameter	Amount	In general problem terms
Total receivables of AhlersRus	288 020,89 EUR	R
Total payables of AhlersRus	1 343 557,26 EUR	P
Bank fee for international transaction	0,5%	C_{b1}
Bank fee for transaction in different currency	0,1%	C_{b2}
Total banking costs on closing the debt	6943,40 EUR	PBC
Comission on buying Bitcoin	0,14%	C_{BTC}
Bitcoin exchange rate at the last day of quarter	963,36$	$r_{t;btc/usd}$
VaR(t+1)	934,25$	$VaR(t+1)$
VaR(t+90)	682,75$	$VaR(t+90)$

Table 10. Data summary

Let's assume that AhlersRus buys bitcoins at the last day of the quarter to payback their debt. Not to loose in the day of transaction we need to take into account the VaR(t+1) of bitcoin on that date.

The amount of Bitcoin needed to obtain is $BTC = \frac{PBC}{r_{t;btc/usd} - VaR(t+1)} = 240{,}74$ BTC. In euro amount that would be 231 925,91 EUR. If the company buys that amount of Bitcoins they won't loose more than the total banking costs they are planning to take because with the probability of 90% bitcoin price won't be lower than 934,52$ per coin.

For buying 240,74 BTC company will pay the fee C_{BTC} for an exchange. That fee would be 371,088 eur.

As the next step the company will perform the payment. As they don't have enough bitcoins to pay all the debt back AhlersRus will pay the remaining part in other fiat currency. To make it in the most profitable way first of all the structure of companies accounts should be analyzed. Company has different fiat currencies. As AhlersRus operates in Russian Federation their income is in rubles. They buy USD and Euros on exchanges.

We can see that Ahlers have a huge debt to the Astros entity but this debt is in the same currency in which AhlersRus operates – in Russian rubles. So AhlersRus is going to send bitcoins to colleagues in other countries to avoid the commission on buying the currency in the bank and the remaining part would be paid to Astros entity in rubles. The banking costs would be the following:

1. Bitcoin payment: 240,74 BTC or 231 925 EUR.
   Remaining debt = 1 343 557,26 – 231 925 = 1 111 631,348 EUR;
2. Total debt to the Astros entity = 1 117 942 EUR, so all the fiat currency left would be spent on the transaction for Astros;
3. Total costs are: $PBC = 231925 * 0{,}14 + 1111631.348 * 0{,}5 = 5929{,}29$ EUR
4. Banking costs savings: $TS = 6943{,}40 - 5929{,}29 = 1014{,}16\ EUR$

The way of performing the payment described previously is illustrated in the figure 8.

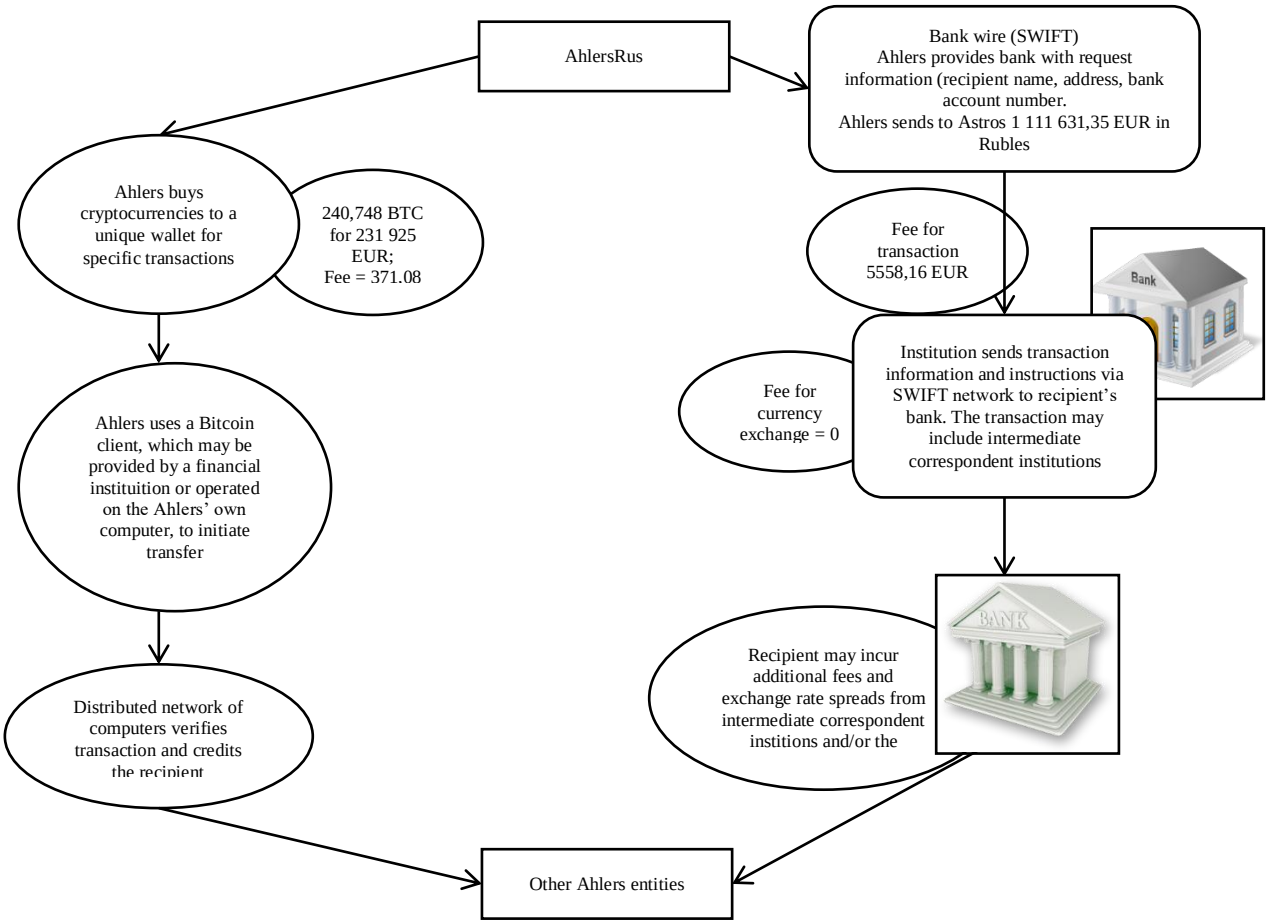


Figure 4. Payment proccess for the last quarter of 2016

Receivables strategy

As the next step the company should decide on whether to store the incoming bitcoins on the account or to sell them immediately. The approach for that decision-making is similar, but the $VaR(t+90)$ is needed, because the calculations are for the whole following quarter.

Total receivables of the AhlersRus was 288 020,89 EUR or 298,97 BTC. VaR for the first quarter of 2017 year is 682,75$ on 10% confidence level. Not to risk to loose all the money which were saved from the banking costs AhlersRus should leave on the account the following Bitcoin amount: $\frac{TS}{r_{t;btc/usd}-VaR(t+90)} = 3{,}70$ which equals to 3570 EUR. That means that Ahlers should sell 295,268 BTC and to leave on the account 3,7065 Bitcoins to diversify risks.

In fact, now we know the real bitcoin exchange rate for the end of the first quarter of 2017 year. It was 1079,22 EUR per Bitcoin against 963,36 Eur on 31.12.16. So the euro amount on the Ahlers account were to increase and become 4000,23 which leads to 429,44 EUR of profit on exchange rates.

To sum it up advantages and disadvantages of that approach should be emphasized.

Advantages:

- High potential for money savings. According to calculations AhlersRus might save 1014 EUR on the banking costs in the last quarter of the 2016 year. If the amount of payments would be the same for the whole year it is only 4056 EUR per year for only one entity;
- Having bitcoins on the account could provide the additional gain based on the growing exchange rate;
- The technology is easy to implement and to use. This technology doesn't need any investment;
- Opportunity to start selling goods and services for bitcoins. That would provide the increase of savings because company would start to earn in cryptocurrency and won't be affected by the commissions of the exchanges.
- High rates of growth of number of business which are implementing this technology. As a time goes by Ahlers will have a bigger opportunity not to buy and sell cryptocurrency on exchange but to have income and spendings in it. That means that the risk of losses on exchange rate would be more diversified;

Disadvantages:

- Hard to decide what to do with the bitcoins on accounts because of its volatility;
- Hard to spend bitcoins out of the company

Conclusions

In the course of the research the following tasks were accomplished. First we were able to understand the mechanism of the work of cryptocurrencies both from a technical and financial point of view. A detailed explanation of the principle of the bitcoin protocol made clear the procedure for the issuance of currency, the formation of its exchange value, the ways of its earnings and exchange, and the possibilities for using it. In addition, due to the analysis of advantages and disadvantages, vulnerabilities, legal status of crypto currency, it became much easier to assess the effectiveness of bitcoins, the value of using this type of currency for each of its potential users.

As a second step the worldwide regulation analysis was performed. From the results of these analysis we can conclude more and more countries are legalizing cryptocurrency payments. That evidence has a positive impact on a cryptocurrencies exchange rate and as a consequence more and more investors are trying to invest in the blockchain technology. As a time goes by, every day, a huge amount of companies which provide blockchain services appear, more companies are starting to implement bitcoin payements in their financial system.

To understand correctly the way of blockchain application to the company's transactional costs reduction case study was performed. On the example of the real company AhlersRus possible savings on implementing blockchain technology as a payment system was shown. The special way of dividing payments on fiat currencies and cryptocurrencies was calculated using the VaR evaluation. The research showed that cryptocurrencies in general and bitcoins in particular may become a way to decrease the banking costs of corporation. Talking about calculations they showed that only one entity can save around 4000 EUR per year without any additional costs for implementing. For evaluating that cost savings a payment scheme was drawn up. What is more, having a bitcoin on balance can provide additional income from the exchange rate changes. For example, calculations shown that if AhlersRus was storing on their account 3,7 bitcoins, which is an exact amount of cryptocurrency which with 90% of probability was not able to cause losses more than they saved quarter before on the banking costs they would gain 430 EUR. As it was mentioned above the exchange rate is growing constantly as a demand on the bitcoin grows all the time. Calculations showed a potential profit from having them on account.

To generalize the results which were obtained from the case study it is possible to conclude that the method which was described can already be a useful instrument for reducing banking costs. What is more, this method has a great potential. Now this method could be profitable only for reducing intercompany banking costs. But as a time goes by and more companies start to use blockchain and this method would become attractive for all kinds of

companies. Having income and spendings in cryptocurrencies would help companies to avoid fees from intermediaries, reduce their banking costs as a consequence and to increase the flexibility of payment system. What is very important everybody can start to use that technology anytime – it is very easy in use.

One more but not less important factor is that a cryptocurrency is a financial asset by itself. Today thousands of agents are operating on the financial market trying to earn on trading cryptocurrencies. The latest trends and researches show that bitcoin rate is going to increase. The demand on them is always growing and as it was mentioned in the first chapter the rate depends only on the demand. For instance, the bitcoin exchange rate only in 2017 year grew up only for What is more it is secured from the inflation by the endless emission. So having them on the account may become a good investing opportunity.

To sum it up it is needed to emphasize that blockchain today can be a profitanble way of transactional costs reduction with the great potential to reduce costs not only by performing intercompany transactions but transactions between companies.

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Appendix 1

Data from AhlersRus

For the consolidation per 31/12/2016 we will fill in following amounts :

Transaction currency (5)	Profit-and loss account 2016 Cost (6)	Income (7)	Balance 31/12/2016 in our favour (8)	in your favour (9)	Explanation (10)
USD		71 336,66			Operational income 1/1-31/12/2016
USD				8 805,00	Receivable 31/12/2016 (for oper income)
USD	200,00				Operational costs 1/1-31/12/2016

Picture 8. Reconcillation act. AhlersRus-AhlersIndia

For the consolidation per 31/12/2016 we will fill in following amounts :

Transaction currency (5)	Profit-and loss account 2016 Cost (6)	Income (7)	Balance 31/12/2016 in our favour (8)	in your favour (9)	Explanation (10)
RUR		14 584,00 ✓			Operational income 1/1-31/12/16
RUR	12 868 534,00 ✓				Operational costs 1/1-31/12/16
RUR				3 559 736,00	Trade payable 31/12/2016 (for oper costs)
USD	17 417,00 ✓				Operational costs 1/1-31/12/16
USD				1 695,00	Trade payable 31/12/2016 (for oper costs)

Picture 9. Reconcillation act. AhlersRus-AhlersKZ

For the consolidation per 31/12/2016 we will fill in following amounts :

Transaction currency (5)	Profit-and loss account 2016 Cost (6)	Income (7)	Balance 31/12/2016 in our favour (8)	in your favour (9)	Explanation (10)
RUR	2 445 157,33				Operational costs 1/1-31/12/2016 (prepayment)
RUR			5 567 939,74		Receivable 31/12/2016 (prepayment)
RUR	393 141,20				Operational costs 1/1-31/12/2016

Confirmed and signed by ...

Picture 10. Reconcillation act. AhlersRus - AhlersLogistics

For the consolidation per 31/12/2016 we will fill in following amounts :

Transaction currency (5)	Profit-and loss account 2016 Cost (6)	Income (7)	Balance 31/12/2016 in our favour (8)	in your favour (9)	Explanation (10)
EUR	498.639,64				Operational costs 1/1-31/12/2016
EUR				94.675,00	Payable 31/12/2016 (for oper. costs)
EUR			528,38		

Picture 11. Reconcillation act. AhlersRus - AhlersPlus

For the consolidation per 31/12/2016 we will fill in following amounts :

Transaction currency (5)	Profit-and loss account 2016 Cost (6)	Income (7)	Balance 31/12/2016 in our favour (8)	in your favour (9)	Explanation (10)
RUR		20 710 393,22			Consultancy / management fees income 1/1-31/12/2016
RUR		250 000,00			Operational income 1/1-31/12/2016
RUR			59 060,74		Receivable 31/12/2016
RUR	6 686 834,69				Rent and communication cost 1/1-31/12/2016
RUR	322 033,90				Organisation cost 1/1-31/12/2016
RUR	80 508,47				Operation cost 1/1-31/12/2016
RUR	61 864,41				Organisation cost 1/1-31/12/2016
RUR	281 697 886,23				Operation cost 1/1-31/12/2016
RUR				69 413 017,01	Payable 31/12/2016

Picture 12. Reconcillation act. AhlersRus - Astros

For the consolidation per 31/12/2016 we will fill in following amounts :

Transaction currency (5)	Profit-and loss account 2016 Cost (6)	Income (7)	Balance 31/12/2016 in our favour (8)	in your favour (9)	Explanation (10)
EUR		162 238,19			Operational income 1/1-31/12/2016
EUR			18 764,64		Reseivable 31/12/2016 (for oper income)
EUR	555 735,90				Operational costs 1/1-31/12/2016
EUR				64 000,00	Payable 31/12/2016 (for oper costs)
USD		1 299,50			Operational income 1/1-31/12/2016
USD	786,00				Operational costs 1/1-31/12/2016

Picture 13. Reconcillation act. AhlersRus - Ahlers Belgium

For the consolidation per 31/12/2016 we will fill in following amounts :

Transaction currency (5)	Profit-and loss account 2016 Cost (6)	Income (7)	Balance 31/12/2016 in our favour (8)	in your favour (9)	Explanation (10)
EUR			63.236,86 √		Trade receivable 31/12/2016
EUR		√ 332.700,38			Operational income 1/1-31/12/2016

Picture 14. Reconcillation act. AhlersRus - Ahlers Klaipeda

For the consolidation per 31/12/2016 we will fill in following amounts :

Transaction currency (5)	Profit-and loss account 2016 Cost (6)	Income (7)	Balance 31/12/2016 in our favour (8)	in your favour (9)	Explanation (10)
RUR		19 709 475,75			Operational income 1/1-31/12/2016
RUR		3 344 327,13			Management fees income 1/1-31/12/2016
RUR		311 864,42			Rent 1/1-31/12/2016
RUR			5 393 294,35		Receivable 31/12/2016

Picture 15. Reconcillation act. AhlersRus - RusImport

For the consolidation per 31/12/2016 we will fill in following amounts:

Transaction currency (5)	Profit-and loss account 2016 Cost (6)	Income (7)	Balance 31/12/2016 in our favour (8)	in your favour (9)	Explanation (10)
USD	237 665,00				Operational cost 01/01/16-31/12/16

Picture 16. Reconcillation act. AhlersRus - Ahlers Singapore

For the consolidation per 31/12/2016 we will fill in following amounts :

Transaction currency (5)	Profit-and loss account 2016		Balance 31/12/2016		Explanation (10)
	Cost (6)	Income (7)	in our favour (8)	in your favour (9)	
EUR		28 531,00			Operational income 1/1-31/12/2016
EUR			28 531,00		Receivable 31/12/2016 (for oper. Income)

Picture 17. Reconcillation act. AhlersRus - AhlersTL