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CASH MANAGEMENT:
HISTORY AND HORIZONS

Cash Management: history and new horizons

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Content

Foreword

The appearance of money is directly tied with the development of human culture. With the advent of trading material values, first means of facilitating this process began to emerge. They only indirectly represented traded values and acted as an alternative to barter.

Even Aristotle in his work Nicomachean Ethics discusses the comparability of valuable materials and proposed using *coin* as a value measurement medium.

Currently, the use of cash worldwide is represented by two vectors of opposite directions. While a number of European countries are clearly reducing the use of cash in favor of non-cash operations (countries include Sweden, the Netherlands, the United Kingdom), others are still more and more dependent on cash (mainly the countries of South and Eastern Europe). The ongoing development of contactless card payments will affect the use of cash, and will also contribute to the deployment of instant payments throughout Europe. However, at present, according to a study by the European Central Bank (ECB), 4 out of 5 retail transactions in Europe are still carried out using cash.

Cash handling is quite expensive. According to expert estimates, the total amount of cash handling costs worldwide exceeds $ 300 billion annually. Moreover, ensuring cash availability is associated with a number of risks.

The high cost of cash handling and associated risks are the main challenges that each central bank faces. Under modern conditions new, more stringent requirements for ensuring uninterrupted payment transactions are introduced regularly. Each individual country has its own unique cash management model. No universal solution currently exists to fulfil this purpose [25].

The company Penkių kontinentų bankinės technologijos (BS/2) of the Penki Kontinentai Group (Lithuania) providing services in 80 world countries has introduced the *Cash Management.iQ* software solution. The specialized solution was designed to manage cash distribution at

cash points (ATMs, electronic cashiers, deposit machines, payment terminals, self-service kiosks, vaults, bank branches and various commercial organizations). The solution automates operational processes associated with cash management, helps maintain the optimal amount of money in cash point networks, as well as reduce the daily costs associated with cash turnover.

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Introduction

Production of the very first goods boosted its exchange between people. However, finding necessary equivalents of products for trade posed a serious concern.

That was the main reason money appeared in the ancient world - the universal equivalent of making an exchange. In the agricultural societies of Mesopotamia around 3000 BC, barley was the most important commodity. Thus, the minimal equivalent of exchange called the shekel, which constituted 180 barley kernels (about 11 grams) emerged. According to this "scale" it was possible to express the value of any product or service in shekels.

Over time, the shekel became a universal measure of weight and it began to be used to measure silver. Since the value of barley depended heavily on the current crop, silver became the new generally accepted stable "currency".

It is noteworthy that in the legislation of the Babylonian king Hammurabi (approximately the XVIII century BC) fines were specified in shekels of silver.

The history of appearance of paper money is as follows: with the advent of banks, they became the custodians of money and basic values. When depositing money, the person received a receipt from the bank. It indicated how much money is in storage with the banker and how much the bearer of this certificate should receive from the bank. Due to the presence of the receipt, it became possible to pay not with coins, but with these receipts.

Gradually, the certificates themselves began to equate with real money. By the way, the word "banknote" comes from the English words "bank" and "note" (i.e., "bank receipt").

And if earlier the economic essence of paper money was in the promise of issuing tangible money, nowadays the banknotes themselves are the same money.

There are several economic theories about the nature of money, and how they can influence the interpretation of historical and archaeological evidence of early monetary systems. Among them is the theory of money exchange, which considers money as a natural result of market activity. It is also worth mentioning the credit theory of money (money in an account), in which the government plays a key role in setting money. The most widespread is the theory of goods. In general, most theories of money mainly focus on the functions, use and management of money.

As a rule, cash is characterized with the following key functions:

- *Means of exchange:* money allows you to trade goods and services without the need for a barter system;

- *Storage of value*: this can refer to any asset, "value" of which can be used now or in the future, that is, this value can be obtained later. This means that people can preserve money now to liquify values at a later date;

- *Unit of accounting:* this applies to everything that allows expressing the value of something in an understandable way and in a way that permits comparing the value of items;

- *Delayed payment standard*: this refers to the expression of the value of a debt. If people borrow today, they can repay their loan in the future in a way that is acceptable to the person who provided the loan.

Money can be classified into:

- *Natural (material) money*. This category includes any goods that can serve as an equivalent of exchange and coins made of precious metals. Examples of such money in the ancient world were silver and gold coins, cattle or grain. It was believed that the value of the denomination of such money is equal to its real value.

- *Symbolic money*. These are signs of value that replace natural money. This category includes credit and paper banknotes, as well as electronic money - digital analogs of coins and banknotes. The nominal value of these currencies is higher than their material worth.

Another category worth discussing is *fiat money:* this currency is defined by the government as the only legal payment denomination. The Latin word *fiat* means *policy* or *decree.*

Fiat currency does not have value in use. Nowadays most paper money is fiat currency, including the US dollar. Fiat currency is not tied to gold and is not supported by other values.

Money circulation is the movement of money in cash and cashless forms, i.e. the sum of transactions that lead to cash circulation.

Money circulation may be subdivided into *cash circulation (cash flow)* and cashless circulation.

Cash flow is cash circulation involving banknotes and coins. It is executed by the central bank of a country (or, say, the bank of the euro zone, uniting national banks of the countries that use euro as their national currency).

Cashless turnover is the movement of money in the cashless form, i.e. in shape of stored values until they are liquified and withdrawn (money deposits). Such money circulation is performed by transferring amounts via bank transactions from the payer to the recipient on mutual terms. Thus, in cashless circulation cash exchanges are substituted by banking operations.

Money turnover is characterized by the following parameters: money amount and money base, money multiplier (the money amount to base ratio), circulation speed.

An important indicator of cash circulation is the money supply - a set amount of money intended to pay for goods and services or to be accumulated by companies, various organizations and the public.

According to forecasts of the Riksbank (the Central Bank of Sweden), Sweden is likely to become a fully *cashless* country in next five years, by 2023[5]. This information was announced at the end of 2018 at the London Banking Conference.

Over 4,000 Swedes had microchips implanted in their hands, which allows them to pay with their hands for railroad travel and food, or to enter their offices without keys. This technology is used in transport, catering, parking, etc.

It is estimated that mobile payment users spend bigger amounts and do that more often that those using traditional payment methods.

In 2018 cashless payments have outnumbered the number of cash payments in the UK, while note and coin use diminished by 15%.

Modern cash management systems become more involved in the banking infrastructure. The times of routine cash amount monitoring come to an end [19].

Overall 164 national currencies are circulated in 197 world countries.

BS2
Penki kontinentai group

COMPETENCE AT THE CORE

International banking technology company that provides solutions for financial institutions and retail business

Chapter 1. Cash as a universal payment method throughout human history

Traditionally, the term “money” implies ordinary metal, paper or other generally accepted non-cash means of making payments for the purchase of goods and services and the repayment of debts.

Currently, money can be issued both physically (the emission by the central bank of a country in form of notes and coins), as well as in written and electronic account (the emission is performed by commercial banks).

Other than its common use, cash possesses a number of other characteristics that are valuable from the social point of view, including its universal use and availability in the fields of high technology of everyday life. Thus, cash is a common value that competes with other electronic payment methods that are more commercially-oriented.

Cash is also a symbol of nationhood, history and culture. Last but not least, cash is considered as the first stage in financial affordability [28].

1.1. The role of currency: the past and the present

In ancient civilizations of Egypt, Babylon or China it was common practice for storage venues to appear near temples and palaces. The venues would issue documents serving as deposit certificates for property held in stock. As those certificates represented goods held in stock, they would often be used for exchange in public markets.

Some other values used in trade included precious stones, copper rods and even large and small livestock. In ancient China cypraea moneta (money cowry) shells tied in fives or tens were used as a currency.

There was even a period in Chinese history when coins were banned to avoid forgery and money cowry shells were the predominant payment method. The traditional Chinese hieroglyph for 'money' was based on the cowry shell drawing.

Then, about 700BC to 500BC coins made from an alloy of gold and silver began to independently emerge in India, Persia and in cities surrounding the Aegean Sea.

The value of coins was determined by the value of metal, from which it was made. It was later decided to introduce "denominations" to reduce money production costs.

It is curious to note that up to the 19th century in Japan the primary measurement of someone's wealth was *koku* – the average amount of rice necessary to feed an adult for a year (about 150kg). *Koku* also served as a currency in Japan during the middle ages: samurai salary as well as province wealth were measured in *koku*.

Paper money were first introduced in China during the Song dynasty in the 11th century. Marco Polo, who has visited the Chinese capital in 1286 noted first paper money. Those receipts were either issued by specialized market stalls or the governmental tax bureau. Such a way of accounting seemed extraordinary to foreigners: as Marco Polo writes, this was a way of payment sought by alchemists.

In Europe the introduction of paper money is associated with the invention of the printing press by Johann Gutenberg. This way proved cheaper than coinage using precious metals.

The first banknotes were receipts with images, stamps and signatures issued to those who stored their values with trusted individuals.

It is believed that the first European banknotes were issued by "Stockholm Banco" (established by Johan Palmstruch) in 1661. In reality, the first paper money (paper "coins") were issued during the Siege of Leiden in 1574. The first experiment failed, however, as the bank issued too many credit banknotes and their value depreciated to the price of paper they were made from. The institution went bankrupt soon after. Similar mistakes occurred in France, the US and China. Banknote issuance was best executed in the UK, where, in 1821 the currency got tied to a gold standard and acquired a fixed price.

In the 18th century the founder of the classical school of economy Adam Smith wrote that in his homeland, in Scotland, farmers often executed payments using iron nails: "real" money was not in demand, while the need to fix something with nails was undeniable.

According to the theory of Adam Smith, money was a type of universally- accepted type of goods [3]. The use of money should facilitate the circulation of values at reduced costs. According to Smith, wealth was formed by gold reserves alone. Money was not considered as method of capitalaccumulation.

1.2. Cash as a universal global payment method

Cash remains the most popular payment method. Its popularity reached its peak in 2008-2009. Nowadays about 70-80% all retail transactions in the Eurozone are cash payments. According to statistics, the amount of euro issued annually grows by 6% [25].

The *World Cash Report 2018* [28] presents information on 47 countries located on every world continent on the status of cash and cashless payments for the last 5 years.

Cash presents a number of unique features, such as full availability and reliability, anonymity and direct payments that do not require a technical infrastructure. These features explain the popularity of cash despite it havinga variety of alternatives.

Profit is traditionally considered the ultimate indicator of a company's success, but some view cash as something more fundamental. Cash remainder is a key factor that determines the competitiveness of a company, it represents resources that are invested in people, technologies and other assets.

The results of the annual independent research *Health of Cash '18* sponsored by the company Cardtronics shows that despite the achievements in digital and mobile payment technologies, cash remains to be the main payment method preferred by the consumer [2].

The above-mentioned research shows that no one method is dominant, all methods, be it cash or any other, has preferences in terms of use. For instance, in 2018, 73% of consumers used cash payments despite other options being available. Consumers value the versatility, security and availability of cash even when digital payments fail. Consumers enjoy the possibility of choosing the payment method, and chose certain methods for specific situations.

In reality, 92% of users enjoy having the choice of payment methods, andthey value the stable nature of money. 37% of respondents claimed that they tend to make cash payments, while 81% of respondents use cash as often or more often than in 2017.

Cash remains the preferred form of giving and receiving money. That is the reality in the world of today, with the constant development of such mobile applications as Venmo and Zelle that allow mobile P2P payments. Though such applications are an essential part of the P2P environment, cash is the preferred payment method for many people.

The development of new payment methods is an indicator of technological evolution, but it does not mean the end of cash. Despite constant emergence of new mobile payment methods, 10% of respondents claim that they would never use such methods to make retail payments.

Over 90% of respondents believe that cash is vital for those who do not have a checking or savings account. Moreover, two thirds of respondent believe that governmental policy should forbid the retail and catering industries to only accept digital payments.

Moreover, those living in the US believe that cash is not only a payment method, but it serves a number of other purposes. 82% of respondents believe that it serves financial responsibility, while 61% of respondents claim that using cash helps them better follow their personal budget. In addition, many associate credit card use with debt, with two thirds of respondents claiming that they do not like using credit cards because of associated debt.

Cash is the only universally-available payment method, disregarding a person's overall income or age. It also serves a number of vital societal needs.

Thus, cash proves competition to existing digital payment methods that are more commercial in nature.

For instance, the US and Canada are essentially different in terms of payment method use (cash and digital) in comparison to such countries as Mexico, Nicaragua and Honduras. As the former have a much more developed digital payment infrastructure (mostly card-based), they are far less reliant on cash in comparison to the other countries located on the continent [28].

At the same time, the countries of Central and South America are heavily dependent on cash. Despite a marked improvement in the infrastructure of payment cards and the growth of electronic payments, cash remains crucial for participation in the economic community. In addition, due to the presence of a relatively large group of individuals without bank accounts, e-voucher solutions are becoming increasingly popular.

In today's world, cash is especially in demand during periods of economic crises, as well as in emergency situations.

According to the World Bank data for 2016, from 29% to 75% of retail payments in various regions (an average of 56% in the world) are made with cash [26].

At the global and continental levels, cash circulation continues to grow consistently. In absolute terms, as well as in comparison with GDP, the relevance of cash in the global economy is constantly increasing. From this point of view, cash will retain its importance for the whole society.

At the same time, in recent years, an increasing number of individual countries have demonstrated a decline in the ratio of cash in circulation to GDP (Kenya, Nigeria, South Africa, Zambia, China, India, Indonesia, Russia, Ireland, Sweden, Argentina and Brazil), which indicates faster GDP growth than cash flow in turnover.

A similar picture is observed with the second key indicator of the use and relevance of cash: an increase in the cost of withdrawing cash from ATMs. At the global level and on all continents, this cost is increasing, indicating a growing need for cash for everyday operations. However, a small number of countries also show negative growth here, indicating a decline in the value of cash. These countries are mainly in Europe and Oceania (Belgium, Ireland, Sweden, United Kingdom, Australia and New Zealand). The same applies to Canada, where the same negative trend was shown when it comes to the cost of withdrawing cash from ATMs.

Payments.iq

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1.3. The pros and cons of cash circulation and non-cash payments

Half of the adult population in the world, approximately 2.5 billion, are not able to participate in official financial services due to their economic status. Most of these people are in developing countries, but even in the developed regions of the world, almost 20% of people do not have access to the banking services.

Banks must comply with a variety of rules and regulations that often prevent less fortunate people from opening accounts. For example, in rural areas, the distance to a bank branch can be such an obstacle. While banks are doing everything possible to expand their financial presence, cash is still the main method of payment for individuals of any wealth.

All over the world, cash is a powerful force - and the easiest, most convenient and reliable way to pay. In addition, there are not so many places in the world where cash is not accepted - and they would not recognize them as a legitimate way of doing business.

Cash retains an important role in various payment systems: despite the regular appearance of new mobile payment services, cash remains a favorite tool for consumers.

It seems that mobile and digital payments define the future form-factors for payment devices. Until now, these form factors had minimal impact on cash transactions in the United States, in contrast to their growing use in the UK and some other countries. Meanwhile, cash is crucial to the US economy.

Innovations and trends affecting the use of cash include digitalization, changes in the retail environment (in favor of online), the expansion of mobile phone and Internet applications.

Of course, technologies such as NFC (contactless payments), QR codes and the integration of electronic payment functions directly from social networking platforms also increase the usability of card and mobile payments.

In addition, expansion of real-time and instant payments allows the user to pay for goods and services in a comfortable way. It covers general needs of consumers and become a strong factor for digital payments to substitute cash.

To describe the infrastructure of electronic payments in [28], the following data was analyzed: the number of issued bank cards and POS terminals.

As it turned out, the average number of cards per capita in the world is 2.0 (while 2016 was excluded because the number of countries that provided data was insufficient for a representative estimate at the continent level).

Meanwhile, the greatest growth was observed in Asia, followed by South and North America. In Europe, the average number of cards per capita is below 2.0.

As for the prevalence of POS terminals, there is on average 1,500 per 100 thousand people (data for 2015). On all continents, there is a steady increase in the availability of POS terminals. At the same time, in Europe, South and, especially, North America, this indicator is higher than the world average.

The growth rate of the availability and use of electronic payment infrastructure and methods such as cards clearly reflect the growing relevance and popularity of electronic payments throughout the world. This is one of the factors of change when it comes to money use.

A recent study by RBR Global Payment Cards Data and Forecasts to 2023 shows that at the end of 2017, the total number of payment cards in circulation in the global market reached 15 billion, which is 6% more than in the previous year. At the same time, the share of the Chinese UnionPay payment system in 2017 accounted for 44% of all payment cards in the world (an increase of 1% compared with the previous year) [22].

Let us also note that the MasterCard payment system is working on a new technology platform for paying bills through the mobile banking applications in real time - the Bill Pay Exchange. Launch of Bill Pay

Exchange service is scheduled for the end of 2019, after integration and testing.

The new service will be connected to the MasterCard network, covering 135 thousand invoicing US organizations. The service will also be supported by a number of third-party vendors, including FIS, ACI Worldwide, Aliaswire, Inlet and Transactis [23].

Naturally, the use of cash is also related to the availability of alternatives. Therefore, the following factors should be considered:

- transaction volumes of electronic payments (credit transfers, direct debit, debit and credit cards, electronic money, others);
- the number of issued debit and credit cards;
- number of POS-terminals.

Straight-Through Processing, (STP). In order to speed up transactions, companies are looking for solutions that offer end-to-end processing. For example, corporate clients are trying to simplify their transaction processing and reduce downtime. These needs may be covered by banks that offer STP services. In order to better serve the needs of corporate clients, banks turn to technology providers, who, in turn, offer optimal cash management solutions.

In developed countries the share of cash in circulation is steadily declining. Thus, in the United States, the provision of compulsory cash acceptance for merchants rests with local authorities: now only 41% of Americans regularly carry cash with them, which creates a demand for alternative payment methods. Such methods include: prepaid debit cards, dual-interface smart cards (frictionless dual-interface cards) and payment through multi-functional outlets (POS systems).

Prepaid Debit Cards. The global market for these cards is expected to reach $ 3.1 trillion. by 2022 [9], which is explained by several factors, including a reduction in cash.

In the past, prepaid cards were mostly disposable (for example, gift cards). However, with the advent of connected devices that help

create a technological, multi-faceted pre-paid option that can become more popular as the number of consumers preferring to pay in cash decreases, the situation has changed. Pre- paid cards and related mobile applications allow consumers to quickly send and receive payments with a few clicks on a smartphone. For example, pre-paid debit cards designed specifically for children, and the mobile applications for parents connected to them, make digital transfer of funds much easier.

Customers who do not use cash can take advantage of similar digital services, such as Venmo, which is conveniently compatible with physical prepaid cards. The corresponding mobile application allows relatives and colleagues to quickly and easily send and receive money through their smartphones and place the balance of Venmo on pre-paid cards for purchases both in regular stores and on the Internet.

The use of pre-paid cards for salary payments has also proven to be beneficial from the point of view of both the employee and the employer. For instance, the recent deployment of the Uber Instant Pay system allows employees of the concern to receive their earnings up to five times a day directly to the pre-paid card.

Dual interface cards. Another trend that supports cash reduction is the transition to contactless payments. To meet growing consumer demand for fast and convenient payment methods, financial institutions use dual interface payment cards. These cards are equipped with a built-in chip and antenna that allow to perform both contact (inserted or read in payment terminals) and contactless transactions (separated by payment terminals). It was shown that teenagers in the US use cash for only 6 percent of transactions.

The ease of use and speed provided by dual interface cards make this payment format convenient for accepting transactions with a small amount. This is one of the key factors that will stimulate the emergence of non-cash trends in consumer payments. It is expected that by 2021 the volume of contactless transactions using debit and credit cards will exceed $ 2 trillion.

EFTPOS fleets. Today, the average consumer uses plastic cards for 28 percent of their purchases, i.e. enterprises that rely solely on cash payments are at a disadvantage. It is expected that during the period of

2017-2025, the EFTPOS terminal market will grow by 11.5%.

With the introduction of new POS technologies, enterprises of all kinds can adapt to the cashless community. Suppliers of software and hardware for POS systems play an important role in advancing the cashless payments, providing an opportunity for companies of all shapes and sizes to accept not only bank card, but also mobile, digital and other contactless formats, whose popularity continues to grow.

New solutions in this area can turn traditional smartphones and tablets into POS systems used by independent companies all over the world, capable of accepting magnetic, chip and contactless cards, satisfying the needs of any client.

Meanwhile, in December 2018, the People's Bank (Central Bank) of China warned about the illegality of refusing cash as a form of settlement in the country, stating that such a practice could ultimately lead to a loss of trust in physical money and an act of injustice towards not accustomed to electronic payments [8].

The message on the page of the official account of the People's Bank of China on the WeChat platform indicates the popularity of electronic payments in the country as Alipay or WeChat payment systems grow. Nowadays they are accepted by public transport companies and in retail.

However, the ease of use of electronic payments caused some manufacturers to stop accepting cash, especially in large cities such as Beijing and Shanghai. The Central Bank of China also pointed out that some local governments are encouraging their advances in technology with slogans like "cashless city". However, this should not mean that they no longer accept cash.

Let us also note that the use of banknotes and coins in Sweden has been declining for many years. The emergence of new technologies, such as instant payments by mobile phones, has led to a practical reduction in cash in the economy to a minimum [4].

Although physical money will not be banned, due to the small number of people and firms that are likely to use them, the cash circulation in

the country will become almost useless.

Merchant Machine, a provider of services for comparing commission payments on trading accounts and cards, published a study that measures the impact of cashless payment on specific industries, personal expenses and the degree of use of the payment method in different countries [2].

With a total of $121.24 trillion in 2017, the United Kingdom was the leading country in Europe in terms of cashless payments. Germany was in second place with $63.4 trillion. France is third with $30.91 trillion.

At the same time, in 2018, the use of contactless payments for the purchase of clothing increased at an annualized rate of 321%.

In 2017, the share of bank card holders in Russia remained almost unchanged, but the number of their active users increased.

Central banks of developed countries are already working on creating their own digital currencies and continue their activities in the usual way, as for most of the last 200-300 years.

Alternatively, central banks could become some kind of regulating and controlling private money for firms seeking to dominate global payment markets.

The international payment system MasterCard presented the results of the annual study MasterIndex in Russia, which showed a steady increase in the popularity of electronic payments among the population.

In 2017, 88% of respondents had bank cards. Most of them were used for payment, which indicates the growth of active users who pay with a card at least once a week. In addition, 56% of Russians alternated cards and cash to make payments, moreover, that 21% of Russians were calculated mainly by bank cards. And only 23% of respondents still use only cash. In 2009, this figure was 84%; thus, the number of adherents of cash payments has decreased over 61 years by 61% [21].

1.3.1. Current payment tendencies in Europe

According to the ECB, 75% of payments at points of sale in the Eurozone are still made with cash - and therefore they continue to be one of the main payment instruments [29].

Each of the 28 EU countries has its own unique problems. Nevertheless, the general trend for the whole of Europe is to reduce the coverage of the national central banks of the countries of the region - as a result of which a number of services are transferred to commercial banks.

The consolidation of retail banking infrastructure that has taken place has led to a decrease in the number of bank branches. There are 15% less bank branches in Europe than five years ago. In Belgium, the Netherlands and Ireland, their number has decreased by 20%.

Currently, 60% of payment transactions in all 28 EU countries are performed using cash (mainly for small payments). In countries where there are no restrictions on cash payments, such payments flourish. In 15 countries where there are restrictions on such calculations (from € 500 to € 15,000) [26], cash continues to be used intensively, especially for small transactions. In addition, in a number of European countries, such as Austria and Germany, cash dominates as the payment method for transactions of any amounts.

In Eurozone, an annual increase of cash circulation can be noticed. In this regard, the ECB maintains a pragmatic approach and maintains a neutral position with respect to various payment instruments. Thus, the ECB welcomes the efforts of national banks to introduce the latest digital technologies, as well as measures taken by such institutions to optimize cash circulation.

In Europe as a whole, there is now a slow growth of cash circulation: an increase in the use of ATMs is approximately 3% per year, and forecasts for the next five years show a decline to 1-3% per year. It is predicted that non- cash payments will grow much faster.

Although it is expected that in future cash payments will have a smaller share in the payments market, there will not be an absolute reduction in cash circulation [27]:

In 15 European countries (including Turkey) in recent years, cash circulation (Currency in Circulation - CiC) has grown by an average of 39.5% in local currency (7.9% per year). One notable exception is Sweden, where this indicator (in local currency) has decreased by 34.9% over the past five years [28].

Thus, there is no reason to assert that there is a reduction in cash (which continues to be an important payment instrument in most European countries).

“Even in this digital era, cash remains essential to our economy,” says ECB President Mario Draghi. According to him, “a study of cash use, conducted on behalf of the ECB, shows that more than 3/4 of all payments at points of sale in the Eurozone are made in cash. In terms of the total value of transactions it amounts to a little more than half. “

Survey results show that in 2016, 79% of all transactions were carried out using cash, which accounted for 54% of the total value of payments. The second most frequently used means of payment was payment bank cards (they accounted for 19% of all transactions, which accounted for 39% of the total value of transactions).

Depending on the country and place of purchase, the cost of the transaction and the demographic characteristics of consumers, the choice of payment method (cash or bank cards) varies. Regarding the number of transactions, cash was used to the greatest extent in the south of the eurozone, as well as in Germany, Austria and Slovenia, where over 80% of transactions were carried out with cash. And the least amount of cash was used in the Netherlands, Estonia and Finland, where they accounted for between 45% and 54% of the total number of transactions.

At the same time, the total number of electronic payments increased significantly: in 28 EU countries 122 billion transactions were made (compared to 94.4 billion in 2012). Since 2016, card transactions accounted for more than 50% of all electronic payments in the EU.

On one hand, some European countries are reducing the use of cash in favor of non-cash; while others still (or more) rely on cash (this trend is typical mainly for the countries of South-Eastern Europe).

As indicated in the ECB report, it is expected that the development of contactless card payments will affect the extent of cash use, since it not only increases the speed of the transaction, but also significantly improves the usability.

Further development of the electronic infrastructure, in particular, an increase in the number of POS terminals, is likely to affect the extent of cash use - as more and more people will be able to count on the ability to make payments in an electronic environment. Other important changes related to electronic payments are the introduction of the 2nd Payment Services Directive (PSD2), which will allow licensed third parties (providers and initiators of payment transactions) to access consumer bank accounts (account access or XS2A) for informational purposes or start initiating transactions.

The main essence of the European Union's PSD2 directive is to encourage new players to enter the payment market, instructing banks to "open a bank account" to external parties. PSD2 entered into force in January 2018. As expected, it will expand the experience of retail payments and lead to a reduction in the use of cash.

Branch Transformation

BANK BRANCH TRANSFORMATION

Technological concept for cash management and customer service optimization inside the bank branch

1.4. Cash management and its role in finance management

Cash management is a wide area of cash collection, concentration and spending, including liquidity measurement, cash balance management and short-term investments. An extensive database of cash management software is described in the internet source [32].

Traditionally, cash management includes settlement products with which one can transfer a part of the company's treasury functions to the bank in order to manage liquidity, payments and cash inflows, and interest rates. As a rule, banks consider cash management services as a set of options useful for a client, from which it is possible to "assemble a mosaic" (the necessary solution for the needs of any particular client). However, the set of elements that make up the proposed line may differ significantly for banks in different regions.

Companies rely heavily on knowing their cash position for managing working capital requirements, such as ordering raw materials, or an acquisition/expansion program, for which they need to have a clear idea of when and how much money is required. These tasks successfully solve effective cash management.

Therefore, for each business it is vital to have defined its cash-related policy:

- Predict when, how, and where monetary needs may arise;
- Identify the most appropriate source for additional cash needs;
- Be prepared to meet cash needs when they arise.

Cash management involves the optimization of cash flows, balances and short- term investments.

"Money" in this context may refer either to cash in the form of currency, or to other equivalents, such as checks, deposits and other assets.

Cash management mainly concerns the management of liquid cash and assets close to cash, such as marketable securities and term deposits, which can be easily converted into cash [3]:

1. **Transaction.** Ready cash balances are vital for normal operations, including purchases, operating expenses, salaries and other payments such as dividends, taxes, etc.

2. **Precautions.** Unforeseen cash requirements may unexpectedly arise as a result of a sudden increase in the value of stocks, delays in receiving receivables, maintaining ready cash balances is important in such situations.

3. **Speculation.** Reserving cash balances is also critical when companies expect lower commodity prices, lower interest rates for buying securities, use discounts for early payments, etc.

In general, cash management for an enterprise is a solution that consists of the following components:

- Bank Account Management
- Liquidity management (bank account management)
- Settlement and cash services
- Interest Rate Management
- Electronic Banking
- Cost control
- Information services
- Bank card projects

Cash collection systems are aimed at reducing the time required to collect company cash, for example, for services rendered to customers.

After the money is collected, most companies begin to concentrate money in one center.

There are many mechanisms that can be used for this purpose, such as wire transfers, automatic transfers in the clearing house and checks.

Another aspect of cash management is knowing the optimal cash balance. Currently, there are a number of cash balance determination methods aimed at minimizing costs and maintaining a sufficient level of liquidity to ensure timely payment of bills.

Functionally, cash management services are combined into three modules:
informational, *transactional* and *related operations*.

The information module provides the client with information on the state of the contract accounts of the corporate units in the country and abroad; balances, debit and credit turnover by amounts, as well as in terms of currencies.

A checking account is a single account that records all operations of a bank with a customer and which considers mutual debts of the bank and the customer.

The transaction module allows the client to carry out payment and settlement operations using the terminals installed in the company (for example, using the Client-to-Bank system).

Related transactions include: monitoring the state of currency accounts, identifying potential currency risks and offering electronic versions of their insurance options; analysis of client's financial indicators for current financial planning and investment decisions (calculation of feasibility for individual investments), determination of capital requirements, cash flow analysis, etc.

Historically, the need for cash management has arisen in the financial departments of corporations in the United States, where differences in the regulation of commercial banks in individual states caused difficulties in settlements between the production units of companies scattered throughout the country. It also led to an increase in the travel time of payment documents, an increase in the volume of funds in the calculations and the loss of a part of the profits. Transformation of leading US companies into transnational ones served their role,

which determined their need for inter-country maneuver with financial resources, protection of proceeds from currency, interest, insurance and other possible risks, minimizing free balances on accounts and profitable allocation of surplus resources.

As a software product Cash Management Solution was implemented at Mellon Bank (U.S.) for the first time in history.

Following the trend, other banks have created either their own local systems or neutral networks with a wide range of users.

Note that for the provision of cash management services, banks, for example, in the United States, use regular postal channels of communication. For this purpose, in the post office nearest to the bank a lock-box, to which consumers of goods or services of the bank serviced by the company send checks to the company for payment. Then the bank regularly takes the documents from the box, deposits the transferred amounts in the appropriate account and by phone informs the accounting department of the client company about the receipt of cash.

1.4.1. Newest cash management optimization technologies

Currently, there is a need to ensure optimal levels of cash and continuous access to cash, including bank branches, vaults, ATMs, smart safes, cash handling devices and other automated devices.

To remain competitive, banks and cash service providers need to integrate technology to predict cash levels, monitor self-service devices, track and align supply, and analyze profitability.

Despite the fact that innovations in payment products occur primarily in the field of electronic payments, they can potentially have an impact on the use of cash, as more and more alternatives become available to consumers. Examples of such innovative products are: online payments, mobile payments, use of contactless technologies (Near Field Communication; NFC) and QR codes (from Quick Response - "quick response"), virtual currencies and instant payments.

The purpose of monetary cycle organization is always aimed at improving the cost-effectiveness regardless of the dynamics of volumes while maintaining the reliability and availability of the monetary infrastructure. In addition, the organization of the cash cycle requires constant effort and investment to maintain or even increase the current level of cost-effectiveness.

The development of electronic payments is stimulated by innovations aimedat facilitating the use of methods for their implementation.

The introduction of instant payments in many countries of the world should be noted as an important example of innovation at the level of infrastructure.

The increased use of mobile phones and wallets (especially in Asia) also encourages the use of electronic payments.

An example of such a system of instant payments is the Unified Payments Interface (UPI), developed by the National Payment

Corporation of India, which simplifies interbank transactions. The interface is regulated by the Reserve Bank of India and works by instantly transferring funds between two bank accounts on a mobile platform. UPI is built on an instant payment service (IMPS) to transfer funds. Being a digital payment system, it is available around the clock and on holidays. Unlike traditional mobile wallets, which accept a certain amount of money from the user and store it in their own accounts, UPI withdraws and transfers funds directly from a bank account when a transaction is requested. It uses a virtual billing address (a unique identifier provided by the bank), an account number with an IFS code, a mobile phone number with an MMID (mobile money identifier), an Aadhaar number or a one-time virtual identifier. To confirm each payment, a UPI-PIN (UPI personal identification number, which is created in the bank's UPI application) is required.

The combination of these technologies, functions and devices allows more people to quickly complete transactions in a consumer-to-consumer or face-to-face retail environment, electronically and instantly. These forms of electronic payments are increasingly acquiring the valuable functions of payment instruments that previously were exclusively in cash (direct settlement, availability, convenience and ease of use).

In South America, on average, only 45% of the population have access to a bank account, and even fewer people have a credit card.

In addition, many do not want to post information about your credit card on the Internet. Recognizing this and looking for ways to stimulate online business, e-commerce sites have begun to accept cash for online purchases.

The solution was found by accepting coded vouchers paid in cash at banks or with affiliated agents. Across the continent, individual payment service provider (PSP) companies or banking communities have been opened. Among the leaders in the cash payment market are Boleto bancário (Brazil), Oxxo (Mexico), Efecty (Colombia) and PagoEfectivo (Peru).

Cash currently occupies a significant share of Latin American e-commerce, reaching up to 40% of sales in some markets.

Technology remains the driving force in optimizing cash management solutions for corporate clients. According to the latest report of RBR Global Payment Cards Data and Forecasts to 2023, at the end of 2017, the total number of payment cards in circulation in the global market reached 15 billion. As the state and central banks in developing countries continue to expand access to financial services, the number of cards continues to grow, opening up additional opportunities for card systems.

Although China is still heavily dependent on cash, its payments industry is mainly known for its innovations in e-commerce and mobile commerce, social networks and related digital payment methods. It is enough to mention AliPay (a subsidiary of the e-commerce giant Alibaba) and Tencent, the company WeChat Pay (a subsidiary of the popular social networking platform WeChat). Both companies have expanded their market outside of China in recent years. Alipay opened in Europe in 2015, and WeChat Pay followed in 2016, initially focusing only on Chinese users abroad and their service.

QR codes also underlie the boom of digital payments in China. In the USA and Europe, QR codes have not earned - however, in China QR codes are used everywhere — by large retailers, street markets and even beggars.

People can use them to pay at the store by scanning the QR code of the product or showing their personal code to the cashier. Money is deducted from mobile wallets, which are usually tied to ordinary bank accounts.

Despite the fact that representatives of both payment companies admit that China is unlikely to become completely non-cash in the nearest future, they are promoting this concept by holding a “Cashless Pay Week” (first week of August for AliPay), and “Cashless Pay Day” (WeChat Pay).

Services of the Chinese UnionPay payment system via the mobile application are already available in 46 countries of the world. As the company said, 200,000 sellers accept payments by QR code worldwide.

It is important that the cost of withdrawing cash from ATMs in the country increased by almost 69% in the period 2012-2016.

Recent studies show that:

- 74% of those surveyed said they could live for more than a month, having only 100 yuan in cash, and 84% of them said they could accept a full cashless life.

- Since 2012, cash circulation in China has increased annually by 7%.

1.4.2. The SEPA Project (Single Euro Payments Area)

With the support of European government agencies, the European banking industry launched the SEPA (Single Euro Payments Area) Project - a series of initiatives aimed at introducing common tools, standards and infrastructure for retail payments in euros. The goal of the project is to overcome the fragmentation in the retail payment market by transforming different national markets into one SEPA market.

Thus, all payments in euros in the euro area should become internal payments. This is intended to provide users with the ability to make payments in euros across Europe from a single bank account, using a single set of payment instruments, as easily and safely as in the country. [24].

Migration to SEPA involves a wide range of participants: central and commercial banks, government bodies, companies and consumers [17]

To distinguish the central banks of the euro area from those outside the euro area, since the introduction of the euro in 1999, the term Eurosystem has been introduced. Thus, the Eurosystem consists of the European Central Bank (ECB) and the national central banks (NCB) of the eurozone countries. "ESCB" is used to refer to the ECB and the central banks of all member countries.

The main task of the Eurosystem is to "promote the smooth operation of payment systems" [24]. At the same time, the ECB and NCB are authorized to provide funds, and the ECB - to establish rules for ensuring efficient and reliable clearing and payment systems within the EU and with other countries.

The new European regulatory framework for retail payments provides a strategy to encourage the use of non-cash instruments and supplant the use of cash, which continues to be the primary means of payment.

In particular, the Bank of Italy, together with the banking and financial community, makes special efforts in this direction. To this end, the Bank

of Italy in 2009 conducted a review of the costs of retail payments in order to deepen a general understanding of the economic efficiency of various payment instruments.

The introduction of Payment Services Directive, (PSD) into Italian law has expanded the range of organizations (payment institutions) that areauthorized to provide payment services in addition to traditional intermediaries (banks and electronic money institutions).

In order to build confidence in modern cashless tools, the directive provides incentives for using secure electronic tools (for example, allowing vendors to offer discounts to customers who use such tools). In addition, at the level of the European Community, other measures were also taken, in particular, EU Regulation 924 of 16 September 2009 on cross-border payments within the EU, aimed at modernizing retail payment services and enhancing the competitiveness of the euro area.

ESCB also agreed on rules for all payment services, speeding up the acceptance of SEPA payment instruments. The Payment Directive PSD directive creates a harmonized legal basis for payments and establishes a general legal basis for SEPA, thereby ensuring that payments (in particular, credit transfers, direct debits and card payments) can be safely and securely made within and between different states - by members. It also establishes the concept of "payment institutions" - licensed payment service providers who can provide them throughout the EU in a lightweight, compared with the banks, supervisory regime.

The original "Directive 2000/46/EC of the European Parliament and of the Council of September 18, 2000 on the occupation, implementation and supervision of business activities of institutions in the field of electronic money" was aimed at regulating market access for a new type of payment service provider. In accordance with its provisions, e-money issuers (that is, funds stored on an electronic device that can be used as a means of payment with respect to third parties) were partially equated to credit institutions.

In particular, the issuers of electronic money were required to authorize and supervise in order to create equal conditions for the

issuance of electronic money and a "single passport" for the provision of such services. Thus, the Directive aims to facilitate the provision of electronic money. The revised Electronic Money Directive establishes a simplified supervision regime for electronic money institutions, reducing initial capital requirements from €1 million to € 350 thousand, and introduces new rules for calculating own funds of electronic money institutions. Its goal is to facilitate the development of innovative services in the payments market and the abolition of the exclusivity principle for e-money institutions operating in other sectors (for example, in telecommunications).

Thus, the directive expands the range of activities that electronic money institutions are allowed to perform, and at the same time softens their supervision. In addition, e-money institutions are no longer considered credit institutions.

Changes in the institutional structure occurred as a result of legislative and regulatory measures aimed at strengthening the reliability of the Italian payment system, encouraging the use of new payment instruments; and harmonization of Italian legislation with European standards [17].

The process of European financial integration has changed the system of interbank payments. The emergence of SEPA has also led to changes in the institutional structure governing the provision of payment services.

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Chapter 2. Specialized solutions for cash management

Despite the variety of existing methods of protection against counterfeiting of money, not all are applicable for their automatic validation. The reasons for this are difficulties in reading and digitizing the security element of a bill, or the lack of clear criteria for checking / rejecting bills, or the simultaneous influence of both causes.

However, in practice, a special technique is widely used to automatically detect counterfeit banknotes - despite the fact that the best validator of banknotes is still a living expert.

2.1. Cash validation and counterfeit processing

The most common bills in the world have a variety of signs that are perceived only by a person, and their number is growing from year to year.

Watermark. The images created by sections of paper of different density, they are visible to the light.

Security thread. Metallic or polymer tape embedded in the paper. Such a thread can be simple or with breakages. The latter repeatedly goes to the surface of the sheet and plunges back.

Microprint. Banknotes may contain tiny symbols, usually with a denomination of the nominal value or the issuer, or just small elements that are visible only under magnification.

Protective fibers. Scraps of colored threads, imbedded in the paper. The fiber can be simple or woven from several threads of different colors.

Microperforation. Laser punched identical small holes that make up an image or an inscription. Like watermarks, they show up to the light. The relief of the holes should not be felt with the fingers, the paper around them should not be charred.

Relief printing. Inscriptions and drawings, distinguishable to the touch. Carry out both utilitarian function (tags for blind), and function of protection against counterfeit notes.

Kipp effect. Corrugated surface area; On the side faces of the riffles, an image is visible, visible only at a certain angle.

Combined images. An image of different elements of which are located on different sides of the sheet. When looking at the lumen of the parts must be precisely suited to each other and give a complete image.

Heads seal. Thin lines, the color of which changes along the line without visible interruptions and without crawling of colors one upon another. Regular multi- color printing will inevitably give in this case a color registration error.

Stamping foil. Figure, made of metal foil, pressed to the surface of the paper.

MVC. Moire stripes of various colors, visible at a certain angle when the banknote is tilted.

OVI. Optically variable image. An element that changes its color depending on which angle to look at it.

Hologram. An element that gives a three-dimensional holographic image that rotates when a banknote is tilted.

2.2. Cash counting, sorting, packaging and marking: from manual processing to electronic accounting systems

Currently, banknote counters are widely used in banks, stores, exchange offices, etc. They are designed for quick cash counting and rejection of counterfeit or damaged bills.

Conventionally, such devices are divided into certain categories: *basic models, digital* and *portable*, *banking* and *office* [13].

Over time, the banknote counters require clearing, since dust is quickly accumulating inside the machines. The more expensive the model, the more serious protection it has against dust, and preventive regular actions can be carried out promptly by the cashiers themselves.

Validation (detection) of banknotes during accounting is performed by almost all models, however, in cheap devices it does not work - or it works poorly and with false results. Accordingly, expensive cash counters are preferred.

The choice of banknote counters is usually guided by the following criteria:

The counting mechanism of such a device may have a vertical or horizontal loading of banknotes. The first option, as a rule, is characteristic of budget devices. The point is in flipping and splitting banknotes during one process. With horizontal loading, the process goes 3-5 times faster, bills can be added during the process of counting.

The device can carry out the validation of banknotes simultaneously with counting. Possible options for checking notes in such devices include IR (infrared) and UV (ultraviolet) check, as well as recognition for thickness, magnetic marks and sizes.

However, even the presence of multiple detectors does not guarantee the accuracy of verification. In addition, cash management is significantly complicated, since false detection can occur at each step of validation. The “golden mean” is considered to be UV detection

(for detecting gross fakes). For the most accurate screening of fakes when counting money, digital models are recommended, for which firmware updates for new samples of banknotes and their fakes are issued regularly.

Enhanced packaging. This option is useful when counting money from the cash register. Expensive models allow you to change the size of the pack.

Additional or remote display provides ease of counting.

Auto summation of banknotes of various denominations. This option is available on digital counters. During the process, fake notes may be sorted out while all denominations will be identified. After the counting, the cashier gets the total amount of the entire pack of bills by various denominations. In such devices it is also possible to sort by orientation, side or denomination.

Sort by parameters. This option involves the sorting of packs from one - into many, considering the set parameters to reduce the time of the cashier. In this case, all suspicious banknotes will be rejected without interrupting the account in a separate compartment. Possible parameters for sorting - at par, the detection of scotch, by side / orientation, by decay.

2.3. Technical equipment for cash storage and protection

Cash withdrawal and deposit services with the use of convenient self-service terminals has already become a generally accepted standard for financial institutions.

Currently, there is a large selection of cash handling equipment and self-service devices, which are successfully used in various industries. This equipment allows storing, processing and ensuring the security of cash and non-cash payments, as well as managing the queue. We will look at some of itstypes.

These include ATMs manufactured by Diebold Nixdorf devices for validating, counting, packing banknotes, etc., which harmonizes the processes associated with cash in retail outlets, bank branches and cash centers.

These ATMs are available in the following categories: *monofunctional* (cash withdrawal only), *multifunctional (*cash withdrawal and deposit) and *cash recycling systems (CRS)*.

We note the line of Diebold Nixdorf ATMs – CS (ex-CINEO) and ProCash, which are distinguished by high security requirements, transaction speedsand the latest banknote recognition technologies.

A monofunctional ATM is a self-service device designed for both indoor and through-the-wall installation. This type of ATMs have the function of cash withdrawal and may provide information about the balance of bank client account. Monofunctional ATMs have the ability to use up to 5 cassettes that provide the best ATM configuration for optimal cash flow: for example, CS 2550 (CINEO C2550) is a monofunctional ATM for outdoor installation, CS 280 (ProCash 280) is a monofunctional ATM for installation in indoors, CS 2020 (CINEO C2020) is a monofunctional ATM of newdesign for indoor installation.

A multifunctional ATM is a self-service device for installation in the premises, as well as on the street. It has the function of cash withdrawal and deposit, providing information about the balance of

bank client account and QR-code transacions. Using some models of these terminals there is an opportunity to implement assisting banking features and print statements at A4 format. CS 2070 (CINEO C2070), CS 2080 (CINEO C2080), CS 2560 (CINEO C2560), CS

2560 Drive-Up (CINEO C2560 Drive-Up), CS 2590 Island Drive-Up (CINEO C2590 Island Drive- Up), ProCash 281.

A recycler is a self-service device type with the functions of cash withdraw and deposit, as well as a continuous turnover of cash due to the possibility of issuing banknotes previously received from the client. This significantly reduces the cost of CIT services and optimizes cash flow.

Fig. 1. CS 4040 recycling system (left), C6010 electronic cashier (right).

As an example, CINEO C6010 (automated teller safe for service areas), CINEO C6020 (integrated system of closed cycle of banknote turnover for operating cash), CINEO C6030 (desktop model of CINEO family with the ability to work in closed loop mode).

Complex system of the closed cycle of a turn of banknotes for a cash zone. CINEO C6010 integrates with a POS terminal and provides the ability to deposit or receive banknotes in full compliance with the requirements of the audit. The system configuration is possible, allowing to deposit and withdraw cash either to the cashier or directly to the buyer. The CINEO C6010 system also offers a closed cash transportation environment to the operating cash desk. When used in conjunction with the CINEO C6020 cash module, it is possible to organize a closed cycle of cash turnover within the store. In the case of simultaneous use of the system of closed circulation of coins, it is possible to fully automate the processing of cash on hand.

Another successful type of banking equipment, the automatic deposit machine, is described in Chapter 2.5.1.

Devices for processing cash are represented by professional counters and currency detectors, sorters and packers DoCash. All of them are easy to use, have a high speed and compact size. In addition to the cash handling devices listed above, BS/2 also offers a currency exchange rate board or other visual information for customers.

With the development of color printing technology, counterfeiting has become widely available, and the number of high-quality counterfeit banknotes is growing from year to year. It is almost impossible to distinguish counterfeits from genuine banknotes without the help of specialized equipment.

The DoCash detector line provides validation (operational check) of banknotes, securities and passports. As an example, you can use the DoCash DVM IR currency detector. It can be used in various cash departments of the bank, retail outlets, services and elsewhere.

Banknote counters with the sorting function are designed for high-quality bills and simultaneous verification of banknotes for authenticity. Ultramodern technologies of recognition of banknotes allow to process cash with maximum accuracy, while significantly saving time.

As such, the banknote sorter Julong JL-303 was successfully tested and recommended for use in credit institutions by the Bank of Russia. Julong JL- 303 sorter is used to prepare cash for loading into an ATM, to sort out old banknotes taken out of circulation, to accept mixed deposits, to pay cash for the day, to separate banknotes of a given denomination for issue to a client.

During operation, there is an opportunity to send the number of counted banknotes to a PC or a printer via USB interface. The detalization covers counterfeit and suspicious banknotes, date and time of the report and the name of the operator.

2.4. Cash storage and transportation: specialized CIT methods

Financial institutions are required to provide cash for the growing number of cash points, including branches, vaults, ATMs, smart safes, and other automated devices. Retailers and service providers are also seeking to reduce costs and improve cash supply chain management.

Cash-in-transit (CIT) is the physical relocation of cash from one place to another. Locations of cash include cash centers and branches of banks, ATMs, large retail chains and other premises that store large amounts of cash due to the installation of devices for the sale of various goods, parking meters, etc.

Many cash transportation businesses are private security companies that offer cash handling as part of their services.

According to the law, CIT is considered a private security logistics company and therefore must comply with transport and security laws. In a number of countries, the carriage of cash has its own legislation (see Chapter 2.4.1).

The CIT industry is governed by national, regional and local laws, social norms and current practice. Responsible bodies are usually the Ministry of Interior, the Ministry of Justice and the police. Legislation and regulations may establish requirements and restrictions regarding the use of firearms, types of vehicles, the minimum number of crew members and the use of intelligent banknote neutralization systems.

CIT services can be performed on unarmored (soft-skinned), semi-armored or armored vehicles. The use of unarmored vehicles is generally allowed only if alternative protection methods are simultaneously used, such as intelligent banknote neutralization systems.

The term encashment comes from the Italian word incassare, which literally means “to put in a box”.

The legislative definition of collection in relation to cash means their collection from customers (including those delivered by customers through automatic safes) and delivery to a credit organization or its internal structural unit with subsequent transportation.

Transportation and collection of cash are carried out by CIT staff, whose number is determined by the head of collection depending on the amount of work and the complexity of performing the specified operations.

Transportation of cash can be performed by one or more cash courier, accompanied by security guards for the safety of these workers and the safety of the cash carried.

For the transportation and collection of cash, credit organizations, internal structural units use specialized vehicles equipped with armor protection in accordance with the established requirements of local legislation, as well as means of communication and other means necessary to ensure the safety of cash collectors, CIT security officers, drivers and values.

2.4.1. A comparative analysis of legislation regulating the private CIT industry in the EU

The study [18] details the following aspects of CIT:

- Current legal situation (national and regional);
- Social situation (collective bargaining agreements);
- CIT practices and transportation of valuables in the European Union until May 1st, 2004.

The report revolves around four main subjects:

1. The availability of CIT as a profession for individuals and companies: requirements for candidates for managers and employees of companies; special attention is paid to topics such as licensing, training, age restrictions, weapons, etc .;

2. Conditions for CIT operations: what are the practical conditions under which cash can be carried;

3. CIT operation modes: transport organization, property and vehicle transportation requirements, customer role in safe transportation, how CIT vehicles can work on ordinary streets and zones;

4. Incidents during CIT operations: payments and social benefits available to victims and their families.

Most EU Member States adhere to the minimum age requirement of 18 years for security operations or CIT management, as well as the obligation to wear a uniform and a service certificate.

Subsequently, general EU rules (CIT Regulation) were introduced for the professional international transport of euro cash [42].

In order to ensure the safety of personnel and society, the Regulation provides that a company that wishes to carry out a cross-border cash

transfer in euros must request a specific CIT cross-border license from its Member State of origin, a CIT license is granted for a period of 5 years, provided that the company meets eligibility criteria set out in the Regulation.

The Regulation defines cross-border transportation of cash by road as the professional transportation of euro banknotes and coins by CIT vehicle between eurozone member states for delivery or receipt within one day, except for an individual operations, i.e. between fixed points (point-to-point). Most deliveries or outflows of funds should be carried out in the territory of the host Member State. In this case, in road transport no more than 20% of non-euro cash is allowed.

As a prerequisite for the cross-border transportation of cash in euros, national authorities should allow the company to carry out domestic transportation in cash. There are strict rules, in particular, on the minimum number of personnel, booking cars, personnel training, smart banknote neutralizing systems (for example, painting them with indelible ink in case of unauthorized opening banknote container) and fines for violation of the established rules.

CIT Regulations do not provide for full harmonization of CIT legislation. To a company engaged in cross-border transportation. in cash, the host country rules on the role of the national police force, on the behavior of CIT security personnel outside the vehicle, and on the safety of places where cash euros are being delivered or withdrawn are applied.

The structure envisioned in the CIT Regulations also extends to countries preparing to join the euro area. Regulation 55/2013 extends the scope of the CIT Regulation to those countries preparing for the euro from the date when the European Council decided to change to the euro of the relevant Member State.

The transportation of euro banknotes and coins between the national central bank of the NCB and between printing houses or mints and the NCB, provided it is escorted by the police, is not subject to CIT Regulations.

More than half of EU Member States do not have a specific definitions for a CIT vehicle. For example, in some cases, CIT operations are subject to the provisions of general safety legislation, with the exception of Austria and Germany, where relevant rules are established through their professional organizations, insurance contracts, collective agreements and general legislation. On the other hand, the legislative bases of Belgium, France, Italy, Spain, Luxembourg and the Netherlands give a specific definition of CIT.

In general, CIT is considered “a professional activity on behalf of a third party regarding the transportation of high value goods”.

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2.5. Automated cash collection trend in the retail industry

Despite the growth of electronic payments, cash is still the most popular means of payment among consumers. This creates a whole range of problems for retailers [10].

Merchants must manually collect, count, and verify cash several times, and an employee or transportation service (CIT) must deliver it to the bank, which creates additional costs and exposes the seller to undesirable risks and liability.

A survey conducted by Tower Group Inc., showed that employees of one fast-food restaurant chain can spend 27 hours or more per week for counting, checking, reconciliation and preparation of cash.

The volume of money supply increases by an average of 11% annually, which makes the question of effectively managing its flows extremely important for banks and retail outlets. According to a study conducted in USA in 2013, representatives of more than 43% of retail chains called insufficient optimization when working with cash the main problem for the development of their business.

It is precisely big retail outlets, as places where cash is most actively accumulated, that require the implementation of an effective solution for depositing banknotes and coins. Banks and cash service and CIT providers can operate as independent system integrators, offering their solutions directly to the client.

A recent study by Celent has shown that, in addition to man-hour costs, 23% of cash handling costs are associated with transportation [10]. Pricing for courier services depends on several factors, including the delivery to the vault.

Cash theft is the second largest area of loss for retailers that cause biger losses than card fraud and other threats. According to the US National Retail Federation, reduce of consuming in 2016 cost the nationwide retail economy for loss.

According to a study by IHL Group conducted in 2018, up to 71% of cash-related expenses are the result of operations before workday, such as replenishing stocks at the checkout and closing boxes at the end of a shift.

It is clear that retailers can benefit by streamlining cash processing, reducing transport requirements, faster access to deposits, and improved security controls.

Remote cash capture (RCC) technology and automated cash processing should help retailers improve cash management with processes that easily to track, control, and introduce through various cash points.

Thanks to secure cash collection devices (or "smart safes") combined with cash tracking and reporting software, the implemented RCC solutions initially helped major retailers.

However, excessive initial costs and problems with integration led to the fact that only a few dozen large banks and the largest collectors with armored vehicles began to offer RCC services. At the same time, retailers were tied with long-term contracts; with little flexibility, they could not sufficiently control the choice of hardware and software and their suppliers - and suffered from decentralized data problems.

The essence of the RCC is that representatives of various trade and service enterprises themselves, through special deposit machines, deposit their daily earnings into a bank account. RCC provides each party with an opportunity to reduce cash costs and increases the security of the process as a whole.

From now on, financial institutions can offer unified banking relationships to sellers, regardless of the location of the store. Intelligent safes allow you to provide temporary credit to RCC providers for confirmed deposits in cash - as a result, the physical transportation of cash no longer depends on time.

Automated cash management solutions help retailers analyze their cash positions, giving financial and operational teams a clear view of cash operations in all stores.

This level of organization allows each store to make important decisions regarding staffing, security protocols and procedures, cash flow management, banking relationships, and how often cash is received during transportation.

Any deficiencies that arise can be easily detected and detected using a software system with customizable alerts and customizable reports. In addition, modern RCC devices automatically detect forgeries.

Individual stores can choose a courier based on location, banking relationships, and quality of service to reduce errors and give managers more time to ensure the smooth operation of the store. The importance of new, more flexible RCC solutions cannot be underestimated.

It is no secret that for many financial institutions and retailers the creation of an optimal model for the circulation of cash within an organization is a real "headache." In particular, optimization of the deposit of surplus cash accumulating in retail outlets or bank branches during the working day becomes a problem.

The solution may be the automation of the so-called remote cash capture procedures, when representatives of various (credit, banking) organizations and retail enterprises independently contribute funds through special devices, after which automatic crediting to their bank account occurs [12].

2.5.1. How do automated deposit machines process cash?

The main advantages of automated deposit are the simplicity and security of the process. Automatic deposit machines (ADM), where money is physically deposited, should work reliably and not cause difficulties for ordinary employees of a sales outlet or a bank branch.

Such a solution is most in demand in institutions that have to work with large amounts of cash. In their case, the need for frequent collection and the relatively high cost of each exit can be an incentive for large retail chains, banks and microcredit organizations to make universal use of electronic cashiers of this type.

Due to the high speed of receiving banknotes and relative technological simplicity, the ADM are the optimal solution to reduce the time spent on recalculation, validation, processing, storage and collection of cash. A certified safe, similar to that used at most ATMs, allows storing cash for several days before the arrival of collectors.

ADMs can be installed in specialized premises with authorized access for the employees of the organization and CIT personnel. The device accepts cash at any time of the day and instantly transfers funds to the customer's account. Thus, any liability associated with storage or transportation is removed from the legal entity, since the money in a legal sense is already in the bank account.

Credit and finance institutions and collection services themselves find RCC to be a very convenient measure.

Let us point out the benefits that RCC provides to banks:

- Cash is stored in safe deposit machines, protected from hacking, intentional and accidental damage;
- The large capacity of the bags of deposit machines allows reducing the number of CIT departures and associated costs;

- Remote monitoring of the amount of funds deposited and proactive notifications upon reaching the upper limit allow optimal management of orders for collection at points of sale.

It is noteworthy that the introduction of such solutions even helps the CIT services themselves to optimize costs and reduce risks, as the collection service personnel have the opportunity to work according to their own schedule, not coordinating their arrival and not wasting time waiting for filling of accompanying documents with retail representatives.

The largest private bank of India, ICICI Bank, offers its customers in addition to ATM services more than 1,200 ADMs, which is 10% of the total number of all the bank's self-service devices. Bank analysts estimate that the introduction of ADMs saves up to 20% of the client's time when depositing funds into an account. This contributes to the convenience and safety of the operation, which is directly related to the growth of loyalty. However, the most important advantage from the use of such devices is the redistribution of customer flows that no longer require the assistance of a bank employee to make a deposit. Individuals and small and medium-sized businesses have the opportunity to make various payments on their own at their convenience.

At the moment, other banks are also eyeing the implementation of this already field-proven solution pursuing a global trend of traditional branch shutdown. With a relatively low cost of deposit machines in comparison with ATMs, for emerging markets it really looks like a worthy compromise and a solution to improve customer service with a significant cost optimization.

The benefits of using ADMs are:

- reduction of operating expenses: optimization of collection comes as a result of efficient planning, speeding up the process of collecting funds and reducing personnel expenses (cashiers, tellers, CIT collectors);

- increasing the security level when depositing funds: ADMs automatically validate and recalculate funds, eliminating the

possibility of operational errors on the part of the employee. Due to a variety of sensors, the device can discard false, dilapidated and suspicious bills, counting them at a speed of 10 or more banknotes per second; funds are credited to the client's account instantly, dramatically reducing any criminal risks for the depositor;

- Development of self-service channels: be expanding the ADM network, banks increase the independence of their customers; in addition, in such self-service points, other services can be provided to customers (for example, arranging various payments), which contributes to obtaining additional commissions.

As for retailers, large retail chains introducing ADM are ahead of their competitors in many respects. They have the following operational advantages:

- instant crediting of funds to the current account in the bank without loss of time for transportation, validation and recalculation;

- delivery of revenue at a convenient time without having to adjust individual daily schedules to the working schedule of the bank;

- personnel workflow optimization and reduction of operational errors due to automatic recalculation, validation, filling in accompanying documents and preparing cash for collection;

- greater security of deposit operations, since the values stored in ADMs are considered to be accepted by the bank.

Technological RCC solutions can be used not only by large retail chains, but also by insurance and travel companies, car dealerships, building hypermarkets, wholesale stores and other institutions.

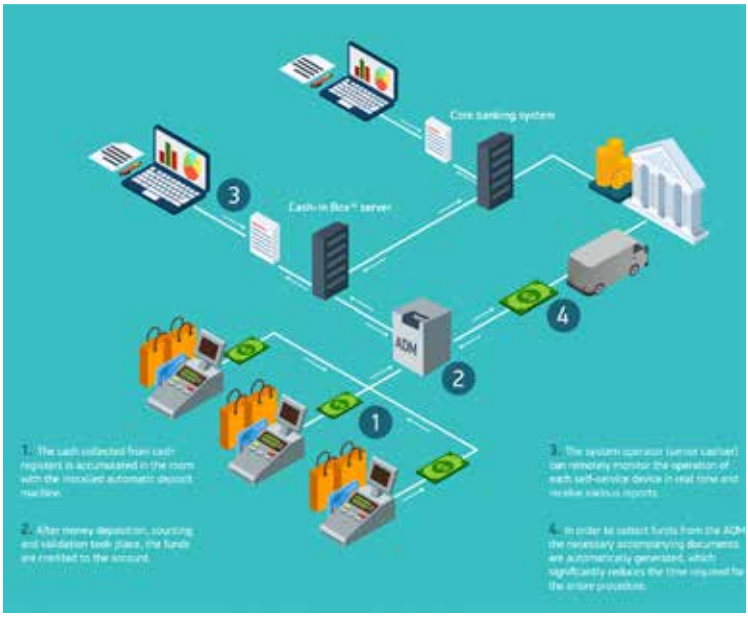

Fig. 2. The technological scheme of remote cash capture.

CIT services can significantly simplify and streamline operations using ADMs. RCC solutions do not pose competition to classical CIT services, in fact, they help develop a more flexible approach when servicing small, middle-size and large businesses.

Let us emphasize a number of benefits of ADMs use for CIT services:

- withdrawal of funds from several legal entities at a single point (shopping
- and entertainment centers, hypermarkets, etc.), which optimizes costs by reducing the number of necessary departures, transportation and personnel costs;
- improving cash security;
- additional revenue from device rental and maintenance.

As an example of success of such projects is the partnership between the Standard Chartered Bank in Dubai and the CIT service Transguard Group, who provide smart ADMs and full bank outsourcing (from device installation and maintenance to CIT brigade operation optimization).

The specialized system *SmartSafe.iQ* developed by BS/2 allows managing ADM workflow and receiving all the necessary analytical reporting. By integrating the system with the *Cash Management.iQ* solution, a bank can create a unified infrastructure for processing and transmitting cash flow data at all cash points serviced by the CIT service.

2.5.2. The new product *Cash-In Box.iQ* for remote cash capture in retail

An elevated interest in remote cash capture in retail was one of the leading trends in the cash management in 2018. The possibility of using ADMs to deposit revenue to transfer the amount onto a retailer's account immediately is a demanded service from the side of banks, retail network and companies. That is the reason BS/2 developed a remote cash capture solution *Cash-In Box.iQ* based on the Cash-In Box deposit machine (Fig. 3).

The solution can become an integral part of the cash management infrastructure for large organizations (banks, microcredit organizations, retail chains, casinos and other gambling companies). Integration with a cash management system of a bank or an independent CIT service will provide significant optimization of cash delivery, reduce the level of unused cash as well as the number of CIT operations.

A comprehensive hardware and software solution *Cash-In Box.iQ* is an automatic deposit machine integrated with the bank's IT system servicing a point of sale that provides efficient and convenient tools for monitoring and controlling the operation of all connected self-service devices. Using the *Cash- In Box.iQ* solution within one commercial structure (shop, bank or post office, casino, sports or entertainment complex) allows building a more transparent system of working with cash, avoiding operational errors and preventing abuse by responsible personnel.

The solution is based on the established operational regulations, according to which the cashier transfers funds to a separate office space for recalculation, checking the authenticity of bills and depositing funds (Fig. 2). The employee can be identified with a personal code, documents or using biometric data. Funds will be instantly deposited onto the specified account, while the operation details remain in the system database.

For transportation of funds CIT services use specialized bags equipped with mechanical locks. Due to the sealing mechanism and the closing

device, the authorized CIT personnel is able to withdraw the bag without having direct access to funds stored in the bag.

The benefits of using the *Cash-In Box.iQ* solution in retail are:

- reducing risks associated with financial gaps, as the revenue is immediately deposited onto a retailer's account and may be used for paying shopping venue rent, salary payments and supplier settlements;
- passing the money handling responsibility to the bank and the CIT service once an amount is deposited. At the same time, the need of insuring cash and investing into back office security becomes obsolete;
- facilitating the work of cashiers, as the need of CIT operation time coordination also becomes obsolete, while the process of depositing no longer requires direct contact with CIT services or filling documents associated with revenue depositing;
- enhanced deposit identification possibilities, as well as the association of the deposit with the depositor, and all associated accounting.

Fig. 3. Cash-In Box 17 deposit machine.

Below are the general technical characteristics of *Cash-in Box.iQ*:

- CIT bag capacity: 15000-17000 banknotes.
- Loading bin capacity: 500 notes.
- Return module capacity: 300 notes.
- Rejected note module capacity: 100 notes.
- Cash processing speed: 1500 notes per minute.
- Cash processing speed adjustability: 17 to 21 notes per second.
- Note validation: based on 4 mechanically-readable attributes, as well as reading unique and serial numbers of notes.
- Accepting up to 10 currencies in "mix" mode.
- Ability to set the amount for recalculation of cash (used to perform expenditure transactions).
- Printing accompanying documentation of every operation.

The company BS/2 recommends using the *Cash-In Box.iQ* solution within the *CashManagement.iQ* system, used for predicting cash demand at each end point (ATM or other self-service device, bank branch or vault), managing cash orders, automatically generating tasks, assigning brigades and routes foreach operation.

SmartSafe .iQ

.iQ Family Product

AUTOMATED TELLER SAFE MANAGING SOFTWARE

Software solution for automated teller safes and its peripheral management that provides automation of in-branch cash handling

Chapter 3. Cash flow optimization systems

The management of working capital or operational liquidity (the speed of converting assets into cash) remains a decisive factor in the long-term financial condition of successful companies.

The company REL of the Hackett Group annually issues a turnover report. According to data for 2014, for 2 years in a row the Top 1000 US companies owned over $ 1 trillion associated with the working capital, which is 6% of the country's gross domestic product (GDP). As for Europe, although the leading 1000 EU companies have actually reduced their net working capital by € 35 billion per year, they still hold a net amount of € 850 billion, or 7.6% of European GDP [15].

One thing is invariable - money was and remains the leading financial instrument. However, companies that are primarily focused on gaining access to outside financing may lose sight of a large hidden source of capital — their own balance [16].

Cash management in banking and other financial organizations have been in development for many years, constantly improving on available functionality. At the same time, the quality requirements are growing. Finding the most appropriate solution for each individual organization leads to the appearance of more popular products on the market. Yet, current trends in the bankingsector are becoming a challenge not only for individual handicraft solutions, but also for highly successful advanced products.

In these conditions, developers of specialized software for cash management have to mobilize their resources and meet the growing demands of the market.

Let us list the basic requirements for cash management systems [19].:

- cash collection forecasting for cash recycling systems;
- tracking the working cycle of banknotes and coins;
- accounting and rejection of old notes;

Complex CIT management

The main driving force for the use of cash management systems is the possibility of direct cost reduction from the reduced number of departures of the CIT service, whose costs for personnel, transport and special equipment are quite substantial. Therefore, developers of specialized software should deeply delve into the work of CIT services to account for such costs to streamline the process of order execution.

Yet, not all cash management systems allow creating optimal routes for collection, effectively manage CIT teams, and offer several route options to reach the final cash points securely. Thus, the actual problems of the specialized cash delivery services themselves remain without the proper attention of solution developers. Deploying an integrated system that includes, inter alia, routine operations of collection services, allows establishing a single organic working environment for the bank, retail outlet and CIT service, seeking operational excellence.

Cash micro and micro management

The modern approach to cash management implies the organization of small, medium and large cycles of cash circulation within a financial institution.

Four specific cycles are possible:

- within a self-service device (recycler);
- within a bank branch or a retail outlet;
- between several bank branches or retail outlets;
- a cycle including whole self-service device networks, bank branches and other cash points, as well as vaults.

It is generally believed that the shorter the cash circulation cycle, the more effectively the organization manages the money supply used. This can be agreed with, with some reservations regarding the practical use of cash recycling devices [19].

Cash flows within each cycle and provide the analytical data necessary for the development and reorganization of the client's infrastructure (bank branches, self-service equipment fleet, etc.). Ultimately, an important requirement for such intelligent systems (along with the provision of standard operating reporting) is the ability to periodically conduct a rapid audit of cash performance within the client ecosystem.

3.1. The work specifics and legislation of cash processing centers and CIT services

A cash processing center is usually defined as a structural unit of a country's central bank operating within its territorial subdivision. Cash processing center activity is regulated by legislation and other norms defined by the central bank.

The main activity of the cash processing centers is to ensure the effective, reliable and secure functioning of the national payment system, and their relationships with serviced credit organizations, authorities, treasury and other customers are built on a contractual basis.

For instance, cash processing centers in Russia perform the following functions [20]:

- Conducting settlements between credit organizations (branches);
- providing cash services of credit institutions (branches);
- storing cash and other valuables, perform operations using these values and ensuring their safety;
- ensuring accounting and control of settlement operations and reconciliation of mutual settlements through correspondent accounts (subaccounts) opened to credit organizations (branches).

A number of these institutions function as specialized credit organizations. All other market participants are engaged in the collection of the banks themselves, as well as the central bank, which is carried out through a network of branches.

Currently, in many countries have strict requirements and recommendations regarding CIT service legislation in terms of the order and security of operations.

Revenue deposit is collection at the cash desks of enterprises, entrepreneurs of cash and their delivery to the cash offices of banks or operational communications enterprises. Revenue includes all cash received at the cash desk of the enterprise, entrepreneur, with the exception of cash received by check at a bank institution.

For example, according to the "Procedure and organization of collection and transportation of cash and valuables in banks of the Republic of Belarus", CIT services are responsible for collecting cash from business entities, as well as transporting other valuables in banks. Collection is carried out on the basis of a general license issued by the central bank of the country [30].

The list of business entities whose revenues are collected by the bank is kept by the CIT service. For each entity a monthly attendance card is compiled. A business entity, depending on the amount of cash proceeds, is given the required number of specialized collector bags. According to the inscriptions and symbols on the bag, it is possible to establish which bank it belongs to and from which client the money is collected during collection.

To collect cash proceeds from business entities, the head of the bank's CIT service draws up routes and schedules, indicating the time of CIT operations, and coordinating them with the territorial law enforcement agencies. The size of the team of collectors (at least three people) depends on the conditions in which the collection is carried out. Weapons and ammunition, along with permission to carry weapons, are issued to brigade members with personal liability.

Collectors check in money bags in accordance to a strict procedure defined by the central bank. After handing over the bags, the brigade seniors hand in all the documents and protective equipment received before the collection to the head of the CIT service. In addition, they hand in arms, ammunition and the permission to carry arms.

In case of emergency, the collection brigade acts in accordance with the protocol.

In North America, cash circulation cycles are organized within country borders, or (as in the United States) within one state. A recent tendency

can be noticed for large banks to outsource all operations of a bank vault to specialized CIT services, while cash is recycled mainly in bank branches [28].

3.1.1. GS1 standards of cash logistics managment

Banks and retailers are faced with the task of providing sufficient cash at various cash points where currency is required to serve their customers.

GS1 is an international non-profit organization that develops and supports global business communication standards. The most famous of these is the standard bar code (symbolic printing on product packaging, which can be scanned electronically).

As such, the German branch of GS1 Germany GmbH is working on priorities to support its banking and retail customers, as well as service and technology providers in developing and implementing future target scenarios in order to benefit from:

- cash optimization with inventory forecasting and capacity planning in logistics;
- tracking orders and shipments, including advance warning and monitoring functions;
- recycling with the sorting of banknote quality and adequate reporting;
- operational risk management for business contingencies and multi-vendor management;
- new ATM technologies for advanced cash cycle management;
- initiated projects to further standardize RFID cassettes and ATMs.

GS1 Germany GmbH sets standards for cash handling - solutions like CashEDI in Germany were just the beginning. The end-to-end adaptation of the GS1 standards allows for further process optimization throughout the entire cash cycle for the cash registers involved [31].

GS1 standards for Auto-ID and EDI communication integrated into information and communication technologies are the main key to the subsequent level of cost management and technically proven sustainability.

Market structure for optimizing the cash supply chain

The financial services and retail sectors are lagging behind in optimizing the cash supply chain. Thus, the increasing pressure on the financial services market creates unique problems for organizations that operate and manage the cash supply chain. Requirements change dynamically - while management's attention is focused on significant cost reductions, risk management,improved integration and automation of cash handling at points of sale cashiers and cash centers.

Banking and retail interfaces determine the need for timely cash and maintenance services, considering the flexible cash inflow and outflow at each cash point. The internal process refers to the dynamic management of the cash cycle in accordance with certain levels of service for transport and cash logistics. The level of optimization throughout the entire cash cycle process can be measured by the availability of devices, such as ATMs, recyclers, field offices, and the associated logistic costs, and the amount ofcash in circulation to reflect stocks in the branches and participating cash centers.

3.2. Cash demand forecasting difficulties and recycling technology

The creation of an algorithm for forecasting the demand for cash at each cash point is highly relevant. However, the introduction of cash recycling systems in the banking sector (ATMs and recycling safes) significantly complicated this task. Due to the possibility of using the funds deposited by customers for the subsequent issue, the forecasting algorithm and proper planning of collection had to be significantly reworked.

As such, a separate device located in a large shopping center can go through several critical cycles during the day: there is a high probability of a shortage of banknotes at the beginning of the day due to the fact that customers will only withdraw cash. However, then the recycler may be overwhelmed due to the fact that small outlets will use the device to deposit revenue.

Thus, the actual availability of the device is at risk for a substantial period of time, and proper collection planning becomes a daunting task [19].

Cash recycling is a technology that is designed to help banks improve network efficiency and overall cash management, reduce costs and total cost of ownership of equipment, and increase security.

After installing the cash recycling function on ATMs, the cash deposited into the terminal can be used to be issued to other customers without a collection procedure. Any traditional ATM with the cash-in function requires regular updating of the deposit cassettes as they are filled, as well as replenishing the cash-withdrawal cassettes. In contrast, an ATM with a cash recycling function helps to reduce the expenses and time of collection by issuing bills already accepted by the ATM.

Another advantage of cash recycling is the automated sorting, checking and rejecting of unusable banknotes.

The innovative terminal Opteva 328 has a flexible architecture, due to which it can be used both as an ATM with the function of a depositary

and / or dispenser, and as a self-service terminal with the function of closed-circuit cash flow. The multifunctional model allows customers to deposit and receive up to 200 notes simultaneously, which contributes to an increase in the number of clients served. The five-cassette configuration of the Opteva 328 provides a turnover of up to 10 thousand bills, and the maximum possible storage volume is more than 12 thousand banknotes. The reliability of the terminal is based on the authenticity of bills when receiving and issuing cash, advanced security modules, including a user surveillance camera, a surveillance camera compartments for receiving and issuing cash and a rearview mirror for customers.

For cash processing within the banking network Teller Cash Recyclers (TCR) are used, which can be installed at workplaces of operational workers who simultaneously perform cashier functions.

Using TCR the following goals may be achieved:

- combining the functions of a cashier / cash operator and carrying out operations for receiving and issuing cash in the absence of a secure cash center;
- eliminating the need for mandatory extraction / replenishment of banknotes, which leads to a reduction in CIT expenses.

Such machines, operating in the cash reception mode, identify the denomination and number of banknotes, check their authenticity, return suspicious, torn and curved notes and isolate genuine but unsuitable for further circulation in a separate compartment, while proper notes are sorted into money drums or cassettes in accordance to denominations. The transaction amount is then determined.

In cash withdrawal mode, at the cashier's request, a given amount of banknotes available for circulation is issued.

Substituting a *cash-in/cash-out* ATM with a recycler allows reducing the costs of:

- CIT operations (up to 45%);
- cash accounting (up to 50%);
- funding (up to 60%).

3.3. State of market of the Cash Management products

Cash management systems in banking and other financial organizations have been actively developed over the years, complementing and expanding their functionality. The growth of customer demand forces the technology to constantly progress.

The market for cash management solutions is quite mature, and many banks offer varying cash management solutions in terms of organization and efficiency. Yet, the market demands, economic conditions and changing corporate trends provide the basis for further innovation in this direction.

Although traditionally a large number of these solutions are still based on Windows OS, many corporate clients involved in Internet banking are now switching to browse-based solutions.

Browser-based solutions facilitate centralized cash management by offering easier user access within the organization and providing better control over cash flows.

Browser-based solutions are computer tools and applications that run in a web browser over the Internet without access to the operating system of any individual computer. These applications are accessible via web pages and can be used by persons who are not allowed to download software applications by firewalls.

Internet banking and Straight-Through Processing (STP) boost payment speed, and thus, process rationalization by eliminating redundant manual processes. A panoramic overview of the accounts gives a greater visibility of the cash position, thereby improving the forecasting ability.

There are some areas that cash management product providers may improve on to ensure better service quality to their customers and improve product competitiveness:

- Elimination of segmented systems: currently, different cash management solutions are offered for different segments. As business grows, managing these systems is increasingly becoming a problem. Therefore, suppliers must offer a single platform that can support various cash management products and services as the business grows;

- Solution customization: today, banks offer similar solutions for all corporate customers, regardless of their size and business. Solution suppliers should offer a custom platform that can serve the specific needs of a wide variety of different enterprises;

- System unification: integrating corporate customer systems with banking systems can help align internal systems with banking systems, and maintain account management between the bank and the customer.

In 2008, Fiserv (USA), by acquiring CheckFree Corporation and CashMaster solution from Global Management Technologies Corp., expanded its Cash & Logistics product line to provide cash demand analysis services.

Let us analyze briefly the following solutions that are part of this product line - ***Integrated Currency Manager, CorPoint, Device Manager.***

Integrated Currency Manager is a web solution for cash demand prognosis that fulfils the needs the requirements for dynamic supply chains, as well as management and transportation of cash through several cash point locations.

Integrated Currency Manager automates cash demand forecasting of ATMs, bank branches, stores and self-service devices based on special forecasting algorithms.

According to the vendor, the solution combines a comprehensive forecast analysis with historical trends and known events to optimize cash reserves for each individual cash point, reducing downtime and costly urgent deliveries. This is achieved, in particular, by:

- optimizing transportation planning, balancing the cost of cash and the cost of their delivery;

- ensuring accurate and timely delivery and reception of cash through tracking and revision;

- countering fraud with notifications regarding unusual deposits, withdrawals, and final balance mismatches that may require investigation.

CorPoint is a flexible solution for cashflow optimization and management facilitation using two modules: *CorPoint: Order Manager* and *CorPoint: Deposit Manager*.

Order Manager automates cash orders through an automated telephone system or an online portal.

The module can be configured to check credit limits, projected order amounts, post-debit entries on trading accounts and electronic transfer of order details to vault transactions and third-party collectors for execution and delivery.

In combination with other solutions, the ***Device Manager*** module of *Cash & Logistics*, acquires, analyzes and responds to information on the status of devices on the network, improves network availability, and provides proactive troubleshooting of self-service devices. It automates problem detection; tracking; dispatch and service provider management; report compilation and distribution. The ***Device Manager*** supports any device or type of currency exchange, including ATMs, kiosks, smart safes, cash withdrawals, self-service devices, currency issuing devices and POS devices.

The ***APTRA OptiCash*** by the US company *NCR* is also worth noting in regards to cash management. The solution monitors the demand for currency in each cash office separately. Based on historical data, event and cost data, it determines the optimal cash position and delivery schedule for each cash point.

The solution serves as the fundamental basis for other cash management solutions: *CashVault* (money vaults), *OptiNET* (a web

interface for banks that helps recover historical data and make cash prognoses remotely), *OptiTransport* (CIT route planning), *OptiReports* (an additional module for establishing dashboards and reports on cash circulation in the system), *Invoice Validation* (an additional documentation module), *Carrier Web* (an additional module for cash order lifecycle tracking), *Vault Balancing* (an additional module for cash replenishment effectiveness evaluation).

The solution provides, in particular, the following functionality:

- cash order management;
- tracking the progress of cash delivery;
- a system of preventive notifications when the lower cash mass limit is reached;
- a variety of analytical templates and data dashboards;
- situation simulation tools to improve the quality of collection planning;
- tools for calculating the amount of money required and the budget for collection;
- analysis of the system performance, the quality of the forecast and the search for anomalies;
- preventive response to the threat of emptying of cash points and cash points.

The software product ***CCO (CashCycle Optimizer)*** by *Planfocus* (Germany) for cash management covers the main stages of the cash supply chain.

The product is based on several cash optimization mechanisms that automatically predict cash flow:

- reduction of costs for collection and costs for internal replenishment by 15-25%;
- reduction of cash reserves, if their costs are significant, as well as a reduction in the cost of refund;

- use of recycling and optimization both in recycler ATMs and in bank branches, which is impossible to achieve with the help of low-tech methods such as spreadsheets;
- improved planning, ordering and cash control procedures.

In addition to optimizing individual cash points, *CCO* uses numerous specialized algorithms to optimize the overall level of cash flow.

Examples of use include: synchronizing multi-note locations (*CCO / Syncro* module); balancing the optimal distribution of cash points on the route (*CCO / Transport* module).

In the daytime inventory is kept continuously (CCO / LiveInventories), and CCO can generate short-term alerts. The CCO Management-Cockpit algorithm allows you to graph important statistics and trends, such as:

- rate of acceptance of orders for payment (i.e., manual changes);
- cash orders are not executed in accordance with the order (i.e., CIT deadlines / changes), etc.

In regards to shortcomings of the CCO solution, it is lacking customization.

CashPilot software solutions from *Sautner & Partner GmbH* (Austria) were developed for professional cash logistics. All ***CashPilot*** standard software solutions are based on analysis and in-depth knowledge of cash logistics processes. These software solutions can be merged, complementing each other without creating redundant data.

When used in synergy, ***CashPilot ATM***, ***CashPilot CIT*** and ***CashPilot OSM*** solutions can optimize the entire cash supply chain, while reducing unnecessary costs.

The ***CashPilot ATM*** solution is meant for cash management at ATMs, in order to predict optimal data on demand, cash replenishment and cost optimization calculation.

ATM monitoring, first and second tier services, cash payment and reconciliation of bills are additional modules of this product.

CashPilot ATM can process cash management data at ATMs and optimize costs for various devices, ranging from ATMs to CDM, CRS and retail terminals, saving time and increasing efficiency.

The product core is an advanced forecasting and cost optimization algorithm based on multiple forecasting and cost optimization models.

It helps:

- solve the tasks of operational cash management in ATMs;
- reduce costs (transportation, inventory, cash handling, administration and management);
- increase availability of cash and ATMs;
- manage retail terminals, cash points and other types of terminals;
- achieve higher efficiency for replenishing, reconciling, monitoring ATMs and coordinating the work of a service engineer.

CashPilot CIT s designed for CIT companies to track and trace real-time actual data on cash handling throughout the network using modern mobile terminals (from smartphones to professional devices) based on Android. There is a KPI toolbar with a frequency of stops, time spent on the route, and time depending on the type of vehicle, region and services.

The CashPilot OSM software has also been developed for route optimization for the cash logistics industry. The joint use of CashPilot CIT and CashPilot OSM provides monitoring of planned and actual transportation of valuables.

The system operator is able to visualize the data, having access to ATMs, banks, customers and other specific service points on the adaptive map.

In addition, using integration with *OpenStreetMap*, the operator can get free access to map data. Licensing of commercial cards from specialized companies also contributes to cost reduction.

The product ***TranzWare Cash Planning*** developed by *Compass Plus* for cash management in ATMs provides a set of complex analytical tools, that are flexible and easy to adapt to changing market demands.

Cash Planning TranzWare (data storage platform) - is a new module that allows you to plan and optimize the work of cash operators and cash vaults. He recommends how much cash should be taken, a place to visit and at what time. Cash management can be performed for both individual ATMs and ATM clusters.

The product is built on the TranzWare data storage architecture, which allows you to easily load the necessary data from other TranzWare products, as well as third-party ATM switches.

Tasks that can be performed include:

- monitoring of cash in an ATM network;
- forecasting the optimal time for replenishment of funds;
- forecasting the optimal amount of cash loaded into an ATM;
- forecasting the optimal amount of money that will be loaded into the vaults, from which ATMs are replenished;
- collecting statistical data to identify regular daily and weekly patterns of changes in the rate of cash consumption;
- built-in report generation subsystem; built-in task scheduler (data uploading, data processing, report generation, etc.);
- notification service.

Cash Management.iQ

.iQ Family Product

CASH MANAGEMENT SOFTWARE PLATFORM

High-end software product that optimizes cash handling processes for self-service devices, bank branches and outlets

Chapter 4. The *Cash Management.iQ* solution by BS/2

For many banks, the days when it was enough to simply monitor the amount of money supply is now history. Nowadays, cash management systems are increasingly being introduced into bank infrastructures.

The multivendor software solution *Cash Management.iQ* developed by BS/2 is a *.iQ* family product (Fig. 4) for automating the processes associated with the optimal distribution of cash at all cash points.

The product, first released in 2014, has been successfully applied by banking institutions and major retail chains.

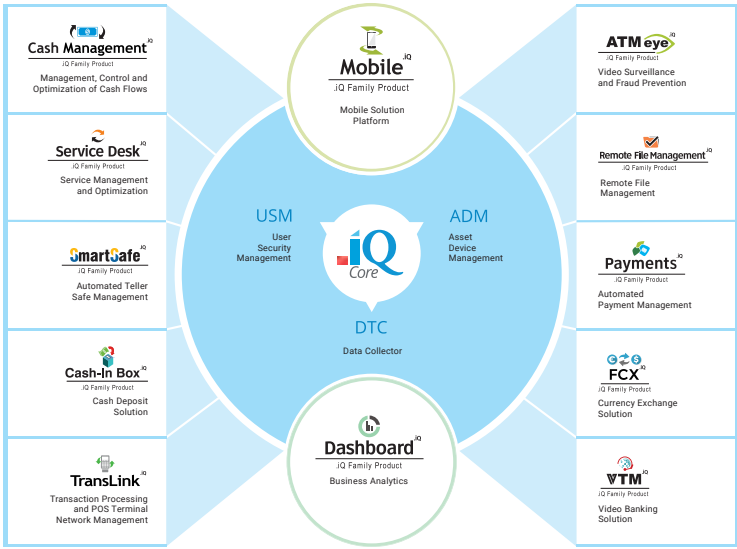

Fig. 4. .iQ product family.

It provides effective cash management within the infrastructure of banking and other financial organizations, forecasting cash demand at each cash point (ATMs, electronic cashiers, vaults, cash settlement offices, payment terminals, infokiosks, etc.).

For ease of use and to ensure the required level of security, *Cash Management.iQ* is divided into 4 basic functional modules that complement each other. The solution allows maintaining the optimal amount of cash throughout the network, optimizing the processes associated with cash logistics and monitoring the progress of collection (Fig. 5). It contributes to reducing up to 30% of operating expenses of banks and collection services.

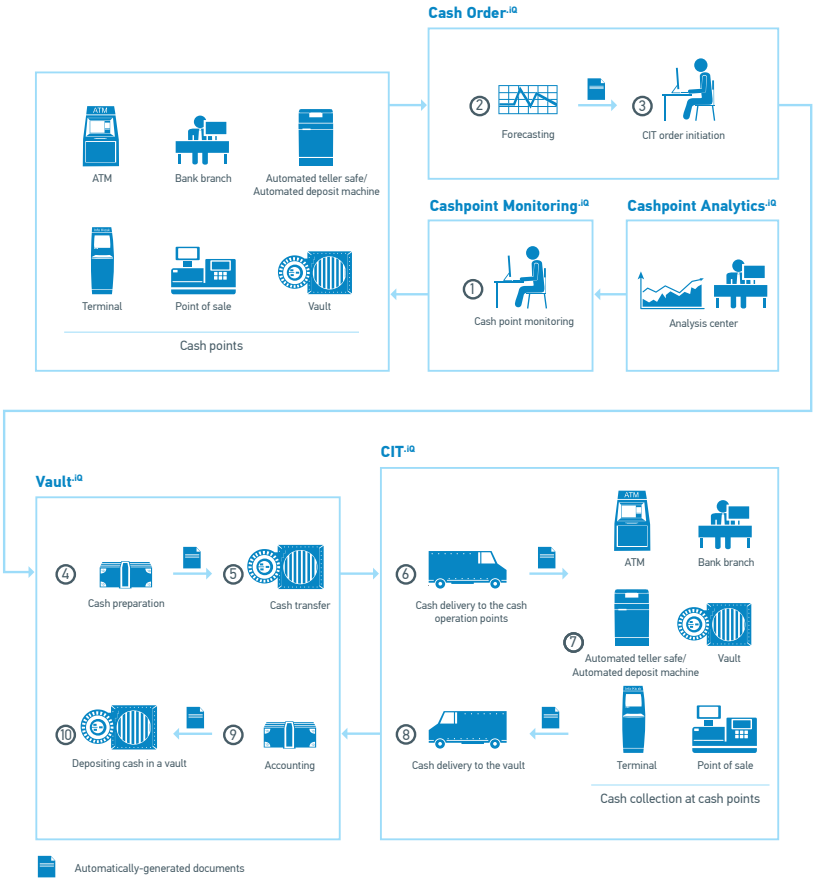

Fig. 5. Cash Management.iQ operational process.

Also, using the additional module of business analytics *Dashboard. iQ*, it is possible to generate reports at each stage of the process and identify trends in quality indicators (Fig. 5).

Depending the business process and customer needs (financial and credit organizations, retail networks, postal organizations, casinos and other cash points), the solution may be applied as a full package or as a combination of its separate modules.

The *Cash Management.iQ* solution helps to reduce the cost of supporting the process of distributing cash, the time spent on planning and generating collection orders. It ensures convenient monitoring of the state of the network of service points in real time with a customizable notification mechanism. It simplifies the organization of cash distribution processes, as well as timely responds to changes in the requirements of the banking services market in terms of cash transactions.

It also allows monitoring the quality of work performance and compliance, optimizing CIT operations on the basis of cost reduction, automating the cash management process and documentation processing, as well as managing risks better (finding a compromise between security and performance).

Using the above-mentionned tools contributes to cash point availability and a significant reduction in the number of violations.

Each *Cash Management.iQ* workstation is assigned a specific role in the operational environment. Every role has a specific module assigned to it, consisting of a number of panels for specific tasks of the role.

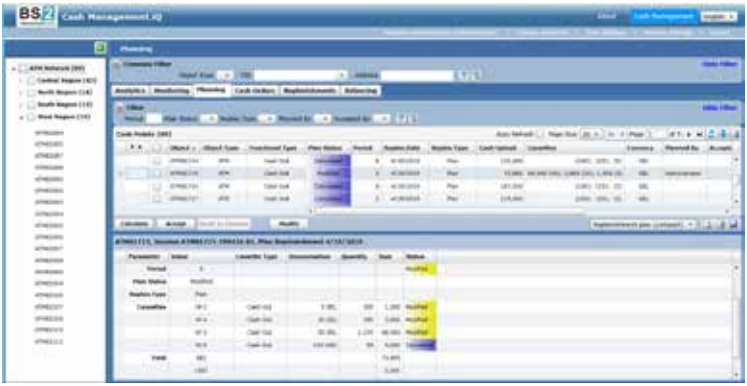

Fig. 6. A standardized workplace interface of Cash Management.iQ.

The standardized workstation interface includes a number of standard components (Fig. 6):

- general menu, where general functionality is provided: change language, password, access documentation, user login / logout to / from the system(s);
- panel menu for switching between different panels;
- data field provides the latest information and functionality of the panels available to the user;
- tree mechanism for customizing device networks according to the user's needs.

4.1. Centralized cash amount monitoring at each cash point (the *CashPoint Monitoring.iQ* module)

Monitoring of cash can significantly reduce the number of CIT operations and save money by planning and making the right operational decisions. As is known, 3 out of 5 cases of non-issuance of funds are related to the operational errors of the CIT service.

The cash monitoring system lets reduce the number of CIT operations by 32% and save up to 10% from the cash that is in active circulation.

The standalone *CashPoint Monitoring.iQ* module provides cash point monitoring of: ATMs of most of the leading manufacturers, payment kiosks, bank branches, stores, etc.

***Fig. 7. Cash flow monitoring across the entire cash point network in the Cashpoint Monitoring.iQ* system.**

Let us discuss the key features of *CashPoint Monitoring.iQ*:

- real-time display of information on each individual object;
- the ability to filter the list of objects according to various criteria;

- sending notifications about the state of objects in real time;
- object reports (total and current balances).

The *CashPoint Monitoring.iQ* module is designed to monitor the cash balance in real time at all cash points with details on available currencies and denominations. The UI makes it is possible to monitor the status of the entire network as well as separate devices.

In particular, **data may be collected on:**

- actual volumes of loaded, issued, received and remaining cash with details on currency types and denominations;
- performed CIT operations: the dates of the last collection, the number of days since the last collection, the number of collections made for a certain period;
- current service condition of objects: “sufficient cash”, “cash is running out”, “long standby period”, “currently under maintenance”, etc.

The following object filters are available:

- object and currency type;
- cash status: empty, overloaded etc.;
- service condition: “available”, “unavailable”, “under maintenance”, “turned off”.

Available notifications:

- upper and lower limit;
- device operating status notifications;
- notifications in the UI and by email.

System reports on the actual amount of loaded, issued, received and the remaining cash with detail by type of currency and denominations

for an individual object or all points of cash. Reports can be unloaded manually or automatically according to the established schedule.

The *CashPoint Monitoring.iQ* module provides a transparent picture of the distribution of funds throughout the network and at each individual point of receipt and cash withdrawal:

- Information on cash balances by type of currency and denominations for selected objects or the entire network;
- Comparative data on forecasted and actual loadings and collection of funds by types of currencies and denominations.

Fig. 8. CashPoint Monitoring.iQ interface.

Detailed monitoring of the state of objects includes:

- current object status: “sufficient cash”, “cash is running out”, “long standby period”, “currently under maintenance”, etc.
- reports on the performance of bank branches and the network of self- service devices;
- physical location of objects on the map with the ability to filter by object status and other parameters.

For different user roles, separate areas of responsibility can be defined using the access control mechanism. In addition, each operator has the ability to customize their individual interface flexibly, displaying the most important data for him.

A flexible access control mechanism allows customizing workplaces so that employees work with exactly the functionality that they need to performroutine tasks.

The latest *Cash Management.iQ* 1.08 update includes a number of features that are especially in demand in the cash management systems market [33]. Most of the new features help simplify the routine business processes of cash management managers, expanding their capabilities and improving the quality of operational decisions made.

Proactive monitoring. The updated product version includes two types of emergency alerts for lower and upper cash limits for both separate ATMs and individual ATM cassettes.

The emergency alert system sends incident reports directly to the email or mobile phone of the system operator. Due to this, the cash management manager can immediately respond and take the necessary measures to eliminate the problem at the cash point.

Services for integration with external systems. The possibilities of integrating *Cash Management.iQ* with external systems have been expanded. The new version has new services for this purpose:

- Web service for the transfer of forecast data can be used to relate the predicted data on the receipt, issue and load of cash with the actual data on each individual object. Such synchronization will contribute to a quick and objective assessment of the quality of the work of cash management managers and the identification of discrepancies between the forecast and the real situation.

- Web service for automatic control of limits designed to coordinate the work of cash management managers and bank employees responsible for financial operations in the bank's

ABS, at the preparatory stages at the cash desk and transfer to collectors.

Data visualization. The *Cash Management.iQ* 1.08 version expands on the possibility of analyzing the quality of the work of cash dealers. Added graphical options for determining the volume of money being returned and the demand for cash during each day.

Features include:

- ATM segmentation table by the "collection period" criterion;
- histogram of the distribution of the amount of collection by the percentage of returned funds;
- line chart for cash withdrawal of a specific ATM during the day.

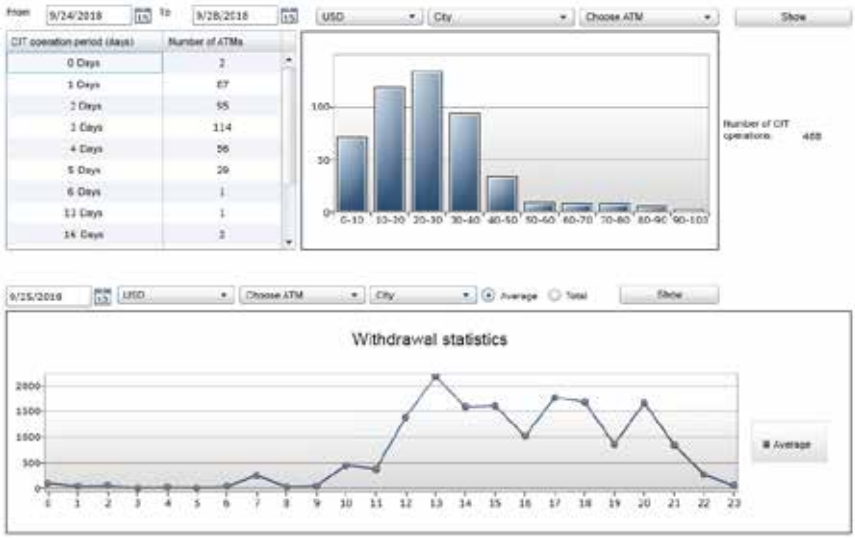

Fig. 9. Upper left: ATM segmentation based on performed CIT operations; upper right: return distribution graph; bottom: 24-hour statistics on cash withdrawal.

The system operator can place an order for the CIT service in order to minimize the risk of re-departure. At the same time the minimum possible amount of cash is loaded.

In practical terms, this contributes to a noticeable decrease in the amount of unused cash and a reduction in the number of planned and emergency departures.

Based on statistical data of cash flow for each individual cash point, the system calculates the expiration date of cash, recommending the optimal volumes and terms of loading or collecting. To perform the calculations, the system uses a prediction mechanism based on neural networks.

Since 2019, the cash management system uses an updated cash demand forecasting mechanism for each branch of a bank, retail outlet or self-service device, making it 10–20% more accurate [34].

Thus, the new mechanism for forecasting the demand for cash will provide substantial savings due to the smaller amount of attracted cash and cost optimization to ensure the work of the collection service.

Therefore, *CashPoint Monitoring.iQ* is an effective tool for monitoring the state of cash in the network of self-service devices, bank branches, retail outlets and other facilities in real time.

The system allows optimizing CIT operation planning, avoiding various critical situations at all cash points, as well as collecting the analytical data necessary to improve the efficiency of a business.

4.2. Cash center automation (*Vault. iQ* module)

Timely provisioning, collection of funds, safe storage and transportation of valuables is a rather difficult logistic task in the control of cash circulation in bank branches and various points of receipt / issue of cash. Its solution is based on the use of effective means of monitoring cash flows, centralized management of collection and the provision of comprehensive analytical reporting.

The *Vault.iQ* module is designed to automate and control the operation of a bank vault, ensuring the successful management of all kinds of internal processes characteristic of monetary vaults, including the most specific ones.

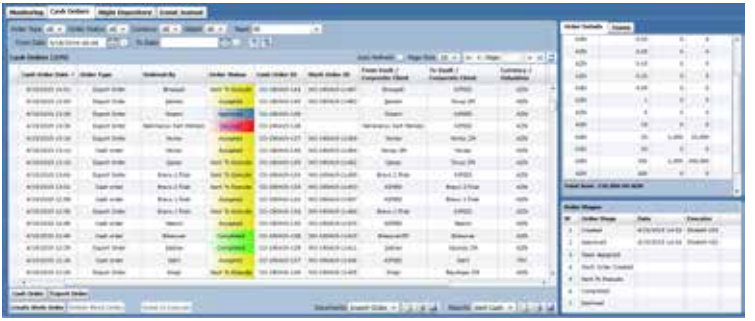

Fig. 10. Main interface elements of the Vault.iQ system.

The main features of the *Vault.iQ* module are:

- Monitoring of cash in a separate storage and the entire network;
- Control of cash limits by currency and denomination;
- Registration, confirmation and tracking of fulfillment of requests for collection (delivery and delivery of cash and other valuables);

- Separate work with evening cash desk operations;
- Flexible system of roles and user access rights;
- Event logging and reporting for each site and the entire network;
- Accounting for dilapidated cash.

With a simple interface, the module provides control of the state of cash in the vaults at the beginning and end of the trading day.

Fig. 11. Balance control and vault accounting in the Vault.iQ module.

Monitoring

- Display of current cash balances at each point and in the entire system in real time;
- Display of cash, planned to be exported from the storage or for its replenishment;
- Notifications about reaching the established limits for currencies and denominations at each point;
- Display of the amount of old cash at each individual point and in the entire system.

Night depository

- Accounting for cash transactions after the close of the trading day;
- The ability to promptly enter data on the arrival of cash in the evening ticket office with their addition to the data of the next day.

CIT orders

- Creating an application for delivery and withdrawal of cash;
- Monitoring the implementation of applications at all stages;
- Control of collector brigades;
- Formation of accompanying documents;
- View the history of completed applications and reports.

Event journal and reports

- Display the history of all completed operations: Day start, Day end, Cash order, Order confirmation, etc.;
- Ability to generate various reports on completed operations.

4.3. CIT operation order and control tools (*Cash Order.iQ* and *CIT.iQ* modules)

The *Cash Order.iQ* planning module provides the ability to determine for each object the optimal number of banknotes (currencies and denominations) and the frequency of cash loading, as well as to place orders for the transportation of cash and various types of valuables (securities, precious metals, etc.).

Order planning and control:

1. Determination of the optimal amount of cash load;
2. Determination of the required frequency of loading funds;
3. Registration of orders for collection;
4. Control of the cash balance.

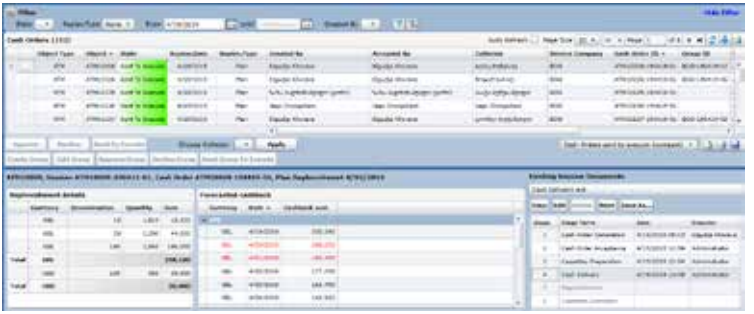

Fig. 12. Planning and placing orders for CIT operations of different cash point in the Cash Order.iQ interface.

With the *Cash Order.iQ* module, one can create cash flow forecasts — that is, forecast cash requirements, plan and execute collection orders for self-service devices and bank branches, as well as set limits on downloadable amounts and cash balances in points: For this purpose, a prediction mechanism based on neural networks is used.

Fig. 13. CIT brigade management, route and documentation creation, as well as brigade monitoring in the CIT.iQ system.

Thus, it is possible to determine the time of collection for each separate cash point on the basis of statistical cash flow data.

Using the *CIT.iQ* module, the CIT brigades are formed, their work is monitored, route lists are formed and optimized, cash is delivered to the destination objects (vaults and branches of banks, self-service devices, and individuals), and collection monitoring is carried out.

CIT.iQ collection control module provides the ability to track the movement of cash at each stage of the workflow, as well as:

- control the composition of CIT brigades;
- determine routes for replenishing cash acceptance points;
- monitor the implementation of orders for collection and receive the necessary statistics.

4.3.1. CIT operation simulation tool – *CIT Simulator*

One of the requirements for intelligent cash management solutions within banking and other organizations is the ability to flexibly tune the system to achieve the best result, that is, the optimal load on each receiving point and issue cash during collection.

For the convenience of bank employees working with *Cash Management.iQ*, BS/2 has developed a special collection simulation tool - CIT Simulator [15].

This modeling environment provides the ability to:

- predict cash flows for a set period in the future for each point in currencies and denominations;
- perform an assessment of the effectiveness of the actual work of cash managers (assessment may be given in the form of comparative graphs or a quantitative monetary equivalent);
- predict dates when it may be necessary to collect each individual point;
- determine the optimal amount of cash to load based on the cash value and cost of collection;
- determine the costs of collection and maintenance of funds in each case.

To build a forecast of future cash flows, a special mechanism is used that processes historical data collected for a certain period at ATMs, payment kiosks and at bank branches.

The following data is used for modeling:

- the date from which the forecast should be formed;
- the period for accounting historical data;
- forecasting period;

- the cost of downloadable funds;
- CIT costs;
- collection regularity;
- possible collected amount per day;
- the lower limit on the amount of cash;
- the average amount of cash returned.

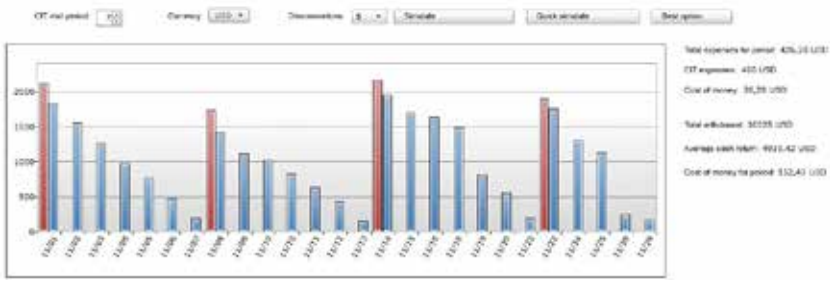

Fig. 14. CIT Simulator.

Thus, a bank employee who is in charge of collection planning gets an effective tool for assessing quality and improving his work. Thanks to this, a financial institution or a CIT company can save hundreds of thousands of dollars a year.

4.4. Key features and benefits of *Cash Management.iQ*

As noted in BS/2 whitepape, the advanced development of specialized software for cash management must meet a number of important requirements.

1. Collection forecasting for cash recycling systems

The ability to use customer-contributed funds, such as cash recycling (ATMs and safe recyclers) for subsequent issuance, greatly complicates the task of forecasting and proper collection planning. This condition significantly affects the creation of a forecasting algorithm, the demand for cash in each point of reception / issue of cash.

Indeed, a separate device during a day can go through several critical cycles: at the beginning of the day there is a high probability of a shortage of banknotes due to the fact that customers will only withdraw cash. However, then the recycler may be overwhelmed due to the fact that small outlets will use the device for the deposit of daily earnings.

Thus, the actual availability of the device may be at risk for an extended period of time.

2. Coin and note lifetime tracking

To unify the procedure for tracking packaged banknotes and coins with modern, specialized solutions, various generally accepted standards are used. In particular, many European banks use the GS1 standard for marking and reading bar codes.

Such standardization allows us to build the most efficient infrastructure for ordering, receiving and redirecting funds to the endpoints at the level of relations between banking cash centers and central bank vaults. Bank or cash collection personnel equipped with barcode scanners perform routine logistic procedures faster and more efficiently, reducing the impact of the human factor.

In the near future, the introduction of standards like GS1 will allow real-time tracking of the path of each pack of banknotes or coins within the cash circulation system of a bank or other organization.

3. Dilapidated note rejection and accounting

Another urgent task of the cash management system is the timely tracking of the number of worn banknotes in the bank system, trading network or other organization.

However, not all suppliers of specialized solutions allow you to adjust the level of decay depending on the requirements of the central bank, limited to screening only the most damaged bills to be replaced. Tracking old banknotes in the system avoids the problem by accumulating banknotes of inadequate quality at the level of regional and central vaults for onward transmission to the appropriate division of the central bank.

4. Complex CIT management

The main driver for the use of cash management systems is the possibility of directly reducing costs on the number of collection services, whose costs for personnel, transportation and special equipment are very high. Accounting for these costs and streamlining the order fulfillment process requires that developers of specialized software software have a deep understanding of the work of collection services.

However, not all cash management systems provide the formation of optimal routes for collection, effective management of collection teams, offering several options to bypass the final points of receipt / issuance of funds for security purposes. Therefore, in these systems, the actual problems of the specialized money delivery services themselves remain without the proper attention of solution developers.

The deployment of an integrated system, including the routine operations of collection services, contributes to the creation of a single organic working environment for the bank, the retail outlet and the cash delivery service.

5. Cash management at micro- and macro-level

The modern approach to cash management implies the organization of small, medium and large cash circulation cycles within a financial institution. Experts identify at least 4 specific cycles: inside a self-service device (recycler), inside a bank branch or retail outlets, between several bank branches or retail points and a cycle that includes a whole network of self-service devices, bank branches and other cash acceptance / withdrawal points as well as bank vault.

In general, it is believed that the shorter the cash circulation cycle, the more effectively the organization manages the money supply used.

Modern cash management systems should manage the cash flows within each cycle and provide the analytical data necessary for the development and reorganization of the client's infrastructure (bank branches, self-service equipment fleet, etc.). Ultimately, an important requirement for such intelligent systems, along with the provision of standard operating reporting, is the possibility of conducting a periodic express audit of how efficiently the cash operates within the client ecosystem.

All of these requirements served as the foundation for creating the *Cash Management.iQ* system.

Let us note the main features of the system:

- **Integration with self-service devices of all manufacturers.** The system works with various terminal equipment that has the functions of receiving, issuing and recycling cash (ATMs, payment terminals, electronic cashiers) of most global manufacturers.

- **CIT accounting at each cash point.** The system has developed the possibility of calculating the cost of collection, considering the cost of transporting cash and assess the feasibility of collection based on the calculation of costs and cost of the transported funds.

- **Flexible limit control.** The possibility of automatic correction of the limits each cash point for holidays and payroll. Thus, the system most adequately meets the actual working conditions of the bank and other organizations.

- **External integration with information systems.** It is possible to integrate with control systems of self-service devices, processing centers and other technological solutions. This improves the efficiency and safety of the entire infrastructure.

- **Night depository accounting.** The solution allows to consider the night depository operations and appropriately control the cash flows received by the bank's vaults after the end of the working day. Due to this, it is possible to separate these operations from those performed before the "closing of the day" and provide a transparent and reliable picture ofthe operation of all points of receipt and issuance of cash.

- **Dilapidated cash accounting.** The system provides separate control over the level of dilapidated cash in vaults and bank branches. Thereby, it is possible to track and withdraw bills of inadequate quality, then hand them over to the central bank.

Historical data is used to optimize the level of cash throughout the supply chain, the level of cash needs. The trends are determined in terms of the structure of the day of the week, the model of the month and seasonality.

At the same time, the cash value is determined by optimizing the cash replenishment time. The optimization function decides the date and amount of the best order, which is transmitted to the order management module for further approval and processing.

Benefits of the *Cash Management.iQ* system:

The demand for cash is accurately predicted for all cash points, which reduces the level of cash by 20-40% while ensuring availability of cash.

- **Automation and optimization of operational processes.** Timely planning and execution of collection orders for self-service devices, bank vaults and branches. Based on the accumulated information, the system automatically predicts the demand for cash at each point, which allows to optimize the operational processes associated with the circulation of funds.

- **Detailed cash monitoring.** Real-time acquisition of detailed information on the availability of funds in self-service devices, bank vaults and outlets, as well as cash collection vehicles at the time of transportation. Technical monitoring of equipment in conjunction with an automatic notification system facilitates rapid response to various incidents.

- **Increasing cash point availability.** The use of the system allows minimizing the standby time of ATMs and ensuring the stable provision of services. The optimal and timely execution of collection provides customers with the need for money and increases loyalty.

- **CIT expense reduction.** Reducing the level of unused cash is achieved by optimizing the load of self-service devices, bank vaults and branches with cash. The system operatively determines the objects to be collected and the amount of loading for each of them, allowing you to plan the best routes for the cash collection service, as well as reduce logistics costs.

- **Improved workflow security.** A flexible system for managing user access rights with restrictions on functionality, operating area, type of cash points and cash points minimizes the human factor and the risk of fraudulent activities.

- **ROI** – complete return of investment in 18 –24 months.

The *Cash Management.iQ* system allows minimizing:

- **CIT expenses** due to optimized planning and reducing the number of emergency operations;

- **Cash costs** due to reducing the amounts of unused cash in ATMs, bank branches and vaults.

The value *Cash Management.iQ* provides is visualized in the table below**:**

Reducing CIT expenses by 10% • **$0,43 in a day** • **$156 in a year for a single network**	**Daily economy, $**	**Monthly economy, $**	**Yearly aconomy, $**
250 ATMs	272,5	8 175	98 400
500 ATMs	545	16 350	196 800
1000 ATMs	1090	32 700	393600

Table. 1. Factual expense reduction

VTM.iQ

.iQ Family Product

INTERACTIVE BANKING SOLUTION

Interactive and video banking solution for mutlifunctional terminals and ATMs

Annex 1. Digital currencies and their future

I. Digital currencies and their differences from traditional money: a quick review

In modern society, all currencies in one way or another become digital, although they are not clearly represented as such. Therefore, for completeness, we will give a brief overview of digital currencies.

The origin of digital currencies dates back to the period of the "dot-com bubble". It was formed as a result of the rise of shares of Internet companies (mainly in the USA), as well as a noticeable increase in their number and the reorientation of old companies to the Internet at the end of the 20th century.

One of the first was the E-gold service, founded in 1996 and supported by gold. Another well- known digital currency service was Liberty Reserve, founded in 2006; He gave his users the opportunity to convert dollars or euros into Liberty Reserve Dollars or Euros and freely exchange them with each other with a commission of 1%. Both services were centralized, and were supposed to be used for money laundering. As a result, they were closed by the US government.

Also, worth mentioning are the Q-coins or QQ-coins that have been used in China as a type of commodity digital currency on the Tencent QQ messaging platform. These "coins" appeared in early 2005. Q-coins were so effective in China that they allegedly managed to have a destabilizing effect on Chinese currency due to speculation.

Digital currency is a digitally-available type of money. Possessing properties similar to physical currencies, it can allow instant transactions and transfer of ownership, bypassing cross-border rules for different countries.

Examples of digital currencies are virtual currencies and cryptocurrencies [35], as well as money issued by the central bank,

recorded in a computer database (including digital base money). Like traditional money, recent currencies can be used to buy physical goods and services, but can also be limited to certain communities, for example, for use in an online game or on a social network.

Thus, a digital currency is a monetary balance recorded electronically on a card with a saved value or other devices. Another form of electronic money is network money, which allows the transfer of value in computer networks, for example, on the Internet. Electronic money is also a requirement for a private bank or other financial institution, such as bank deposits.

Digital currencies can be either centralized, where there is a central point of control over the money supply, or decentralized, where control over the money supply can come from various sources.

Almost all virtual currencies are centralized, and control of the money supply is in the hands of the developers of the virtual world. By the way, most manufacturers of massively multiplayer online games hire experienced economists for this purpose.

Meanwhile, other digital currencies can always pay for physical goods and services, for example, you can order goods through the electronic payment system *PayPal.*

In 2012, the ECB defined virtual currency as "a type of unregulated digital money, which is issued and usually controlled by its developers, used and accepted by members of a certain virtual community". The US Treasury Department in 2013 more briefly defined it as "a medium of exchange, which in some environments acts as a currency, but does not possess all the attributes of a real currency".

According to these definitions, the key attribute that a virtual currency does not possess is the status of legal tender.

A *cryptocurrency* is a digital asset, developed as a medium of exchange, using serious cryptographic protection for financial transactions, controlling the creation of additional units of assets and checking their transfer. Cryptocurrencies use decentralized control, as opposed to centralized digital currency and central banking systems.

The decentralized management of each cryptocurrency is carried out using the technology of a distributed database, usually blockchain, which serves as a database of public financial transactions.

Cryptocurrencies, such as bitcoin, fall into a category other than virtual. Cryptocurrencies are designed to replace cash, and there is nothing virtual about it.

The first decentralized cryptocurrency, *Bitcoin* was created in 2008 by the developer under the pseudonym Satoshi Nakamoto [36]. This cryptocurrency was released as open source software. Since the release of coins, more than 4,000 altcoins have been created (alternative versions of coins or other cryptocurrencies).

S. Nakamoto introduced the concept of electronic coins as a chain of digital signatures. Each owner can transfer his coin by digitally signing the hash values of the previous transaction and the public key of the next owner and adding them to the end of the coin. In this case, the recipient can verify the signature to control the chain of ownership.

Hash function is any function that can be used to map data of arbitrary size to data of fixed size. The values returned by the hash function are called hash values, hash codes, or simply hashes. Hash functions speed up the search in a table or database by detecting duplicate entries in a large file. They are also used in cryptography.

The number of types of cryptocurrency available via the Internet as of August 2018 exceeded 1600 and continues to grow. By market capitalization, Bitcoin by December 15, 2018 became the largest blockchain network, followed by Ripple, Ethereum and Tether cryptocurrencies.

As of February 12, 2019, according to CoinMarketCap, the total market capitalization of cryptocurrency is $ 120.6 billion and exceeds the GDP of 127 countries.

Unlike centralized currencies, coins are mined at a mathematically controlled rate, and their supply depends only on the demand of the free market. This distinguishes them from traditional currencies, such as the US dollar, which follow the decisions of central banks. The

cryptographic basis of cryptocurrency also increases its anonymity compared to any real or virtual currencies. The latter are tracked by banks and developers respectively.

To deal with bitcoin, you need to divide it into two components. On the one hand, there is bitcoin-token, a code fragment that represents the fact of possession of a digital concept - an analogue of a virtual debt obligation. On the other hand, there is a bitcoin protocol, a distributed network that supports the register (database) of bitcoin-token balances. Both of these components are traditionally called “bitcoin”.

The idea of creating a bitcoin was to develop a means of exchange that is independent of the central authority — and which can be transmitted electronically in a safe, verifiable, and unchanged way. At the same time, each of the system participants can communicate with all other participants at any time when money is transferred to the system, which will allow all system users to update the databases in their computer systems simultaneously. Thus, it is possible not only to create backup copies of the database, but also to speed up the execution of transactions - and to simplify the detection of cases offraud.

The created system (“Bitcoin”) allows payments between users without passing through a central authority, such as a bank or payment gateway. Coins arenot printed as dollars or euros - they are produced by computers around the world using free software.

What are the differences between bitcoin and traditional currencies? Bitcoin can be used to pay electronically if both parties are ready for it. However, it differs from ordinary digital currencies in several important properties:

Decentralized. he most important characteristic of Bitcoin is that it is decentralized. No institution controls the bitcoin network. It is supported by a group of volunteer programmers and is managed by an open network of dedicated computers scattered throughout the world. It attracts interest from individuals and groups who are undesirable control over their money by banks or the state.

Thanks to a well-thought-out combination of cryptography and economic incentives, Bitcoin solves the “double cost problem” of

electronic currencies. The problem is that digital assets can be easily copied and reused. In fiat electronic currencies, this function is performed by banks, which gives them control over the traditional system. With coins, transaction integrity is maintained by a distributed and open network that no one owns.

Limited availability. Fiat currencies have an unlimited offer - central banks can issue them as much as they need, and can try to manipulate the value of a currency relative to others. This can cause undesirable costs for currency owners.

With Bitcoin, however, deliveries are strictly controlled by the basic algorithm. A small number of new coins is released hourly, with a continuing decrease in speed, until a maximum of 21 million is reached.

Alias use While the senders of traditional electronic payments are usually identified (for purposes of verification, as well as compliance with anti-money laundering and other legal requirements), theoretically, bitcoin users work under conditions of semi-anonymity. Since there is no central "validator", users do not need to identify themselves when sending coins to another person. When sending a transaction request, the protocol checks all previous transactions to confirm that the sender has the required number of coins, as well as the authority to send them. In this case, the system should not know the identity of the sender. In practice, each user is identified by his wallet address. In this way (with some effort) transactions can be tracked. In addition, law enforcement agencies have developed methods for identifying users when necessary.

Also, by law, most exchanges are required to verify the identity of their customers before they are allowed to buy or sell coins. This makes it easy to track bitcoin usage. Since the network is transparent, the progress of a particular transaction is visible to everyone.

Unchangeability. Unlike electronic transactions with fiat currency, bitcoin transactions cannot be canceled (this is due to the decentralization of the network). If a transaction is recorded on the network and, if more than one hour has passed, it cannot be changed. This means that any transaction in the Bitcoin network cannot be faked.

Divisibility. The smallest bitcoin unit is called Satoshi. It is one hundred millionth (.00000001) of bitcoin (at today's prices, about one-hundredth of a US cent). Thanks to Satoshi, it is possible to carry out microtransactions, which are impossible with traditional electronic money.

To own something in the usual sense, be it real estate or a sum of money, means either personal storage of this thing, or granting the right to store to a trusted entity, such as a bank. However, bitcoins themselves are not stored either centrally or locally, so no object is their custodian. They exist as records in a distributed registry (database), the so-called blockchain (block chain), copies of which are transmitted by a voluntary network of connected computers. "Acquiring" bitcoin simply means being able to transfer control over it to someone else by creating a transfer entry in the blockchain. This capability provides access to a pair of private and public ECDSA keys. For the first time the term "blockchain" appeared as the name of a fully replicated distributed database implemented in the Bitcoin system. The blockchain technology can be extended to any interconnected information blocks.

ECDSA (Elliptic Curve Digital Signature Algorithm) is an abbreviation for a digital signature algorithm based on elliptic curves. The algorithm uses an elliptical curve and a finite field (in the mathematical sense) to "sign" data so that third parties can verify the authenticity of the signature, while the signer retains the exclusive ability to create a signature. When using bitcoins, the signed data is a transaction that transfers ownership.

ECDSA has separate procedures for signing and verification. Each procedure is an algorithm consisting of several arithmetic operations. The signature algorithm uses the private key, and the verification process uses the public key.

A transaction block is a special structure for recording a group of transactions in the Bitcoin system and similar ones. A transaction is considered complete and reliable ("confirmed") when its format and signatures are verified, and when the transaction itself is combined into a group with several others and recorded in a special structure - a block.

The contents of the blocks can be checked, since each block contains information about the previous block. All blocks are lined up in one chain, which contains information about all operations ever performed in the database.

Mining is specifically designed to be resource-intensive and complex, in order to achieve stability in the number of blocks detected by miners on a daily basis. Separate blocks must contain proof of work to be considered valid. This proof of operation is verified by other Bitcoin nodes whenever they receive a block [40].

The main purpose of mining is to establish a transaction history in a way that is not computationally inappropriate to change with any single entity. By downloading and checking the blockchain, bitcoin nodes can reach consensus on the order of events in bitcoins.

In addition, mining is the mechanism used to enter bitcoins into the Bitcoin system: miners receive transaction fees, as well as the "subsidy" of newly created coins. This serves both the purpose of distributing new coins in a decentralized way, as well as motivating people to ensure the security of the system.

On August 1, 2017, a group of developers announced the creation of Bitcoin Cash cryptocurrency, which has a common initial history with Bitcoin.

Another well-known cryptocurrency is **Ether**, which is based on the open platform of distributed computing based on the **Ethereum** blockchain.

Ethereum is also an operating system with intelligent contract functionality (scripts).

There is a reasonable question about the ratio of digital and virtual currencies. According to the ECB's Virtual Currency Schemes - a further analysis ("Virtual Currency Schemes - Further Analysis"; 2015) [36], virtual currency is a digital representation of value not released by a central bank, credit organization or electronic money institution, which in some cases can be used as an alternative to money.

A digital currency can be denominated in a sovereign currency and issued by an issuer responsible for exchanging digital money for cash. In this case, the digital currency is an electronic money. A digital currency expressed in its own value units or with a decentralized or automatic release will be considered a virtual currency.

Thus, bitcoin is not only a digital currency, but also a type of virtual currency. Since bitcoin and its alternatives are based on cryptographic algorithms, these types of virtual currencies are also called cryptocurrencies.

And how do digital and traditional currencies compare? Most of the traditional money supply is bank money counted as being stored on computers. This is also considered a digital currency.

Mobile digital wallets. Some e-money systems use contactless transfer of payments to simplify payment and secure the recipient's e-wallet during a transaction.

- In 2010, the mobile payment service Venmo, owned by PayPal, was launched as an SMS mobile payment system, which has become a social application where users can pay for each other's small expenses. The service is popular with college students, but it has some security issues.

- In 2011, *Google Wallet* was released in the US, allowing you to easily transfer all of your credit / debit cards to your phone.

- In 2014, *Apple Pay* was released as an update to work on *iPhone 6* and

- *Apple Watch*. It is very similar to *Google Wallet*, but is intended only for *Apple* devices.

In 2009, Directive 2009/110 / EC of the European Parliament and of the Council "On the establishment, operation and supervision of organizations involved in electronic money" was adopted, repealing the previous similar directive 2000/46 / EC. [37].

II. Will cryptocurrencies last?

Cryptocurrencies appear almost daily, and attract more attention as a potentially useful investment.

Many existing digital currencies are not yet widely used, and they are not easy to use or exchange. Banks, as a rule, do not accept and do not offer services for them. There are concerns that cryptocurrencies are extremely risky due to their very high volatility and the potential for pumping and dumping schemes. Regulators in a number of countries have warned about their use, and some of them have taken specific regulatory measures to discourage users. The more anonymous the currency, the more attractive it is for criminals, regardless of the intentions of its creators.

In February 2018, Bitcoin occupied 34% of the blockchain industry, but now this figure is above 53%. Over the past year, Bitcoin's share of the digital money market has increased by 56%. Ethereum's figures fell by two times - from 20% to 10%, Bitcoin Cash - three times, from 5.62% to 1.84%.

The value of currency Ether has grown by more than 13,000 percent in 2017 to more than $ 1,400. But by September 2018, it fell to $ 200 dollars.

Meanwhile, in March 2018, the Marshall Islands became the first country in the world to issue its own cryptocurrency and certify it as legal tender called SOV ("sovereign").

In Ecuador, a law passed by the National Assembly of the country gives the government permission to make payments in electronic currency and proposes the creation of a national digital currency. In December 2015, Sistema de Dinero Electrónico ("electronic money system") was launched, making Ecuador the first country with a state electronic payment system.

In 2016, the local authorities of the city of Zug (Switzerland) for the first time adopted a digital currency to pay city fees. They added bitcoin as a means of paying small amounts, up to CHF 200 - in an attempt

to promote Zug as a region for introducing future technologies. In order to reduce risks, Zug immediately converts any received bitcoin to Swiss francs. By the way, the Swiss Federal Railways (the state railway company of the country) sell bitcoins through their ticket machines.

According to a study conducted by the University of Cambridge (UK), in 2017 the number of unique users of a cryptocurrency wallet ranged from 2.9 to 5.8 million - most of them used bitcoins.

However, due to the volatility and unpredictability of cryptocurrencies, it is extremely unlikely that in the future they could replace the current generally accepted money.

FCX.iQ

.iQ Family Product

AUTOMATED CURRENCY EXCHANGE SOLUTION

Software solution for ATMs and other self-service terminal
for cash-to-cash currency exchange automation

III. Central Bank Digital Currency (CBDC) perspective as a substitute for cash

Central bank digital currency (CBDC).

The CBDC currency is different from "digital currency" (or virtual currency and cryptocurrency), which are not issued by the government and do not have the status of legal tender, announced by the government. As such, public digital currencies could compete with deposits from commercial banks and dispute the status quo of the existing banking system with partial reservation.

Although the Bank of England (Bank of England) was one of the first central banks in the world to initiate a global discussion on the prospects for introducing a CBDC, the Central Bank of Sweden (Sveriges Riksbank) is now most close to considering its implementation. In November 2017, the Central Bank of Uruguay announced the start of testing for the release of digital Uruguayan pesos. In the eurozone countries, the former Governor of the Bank of Spain, Miguel Angel Fernandez Ordóñez, called for the introduction of the digital euro, but the ECB has so far denied this possibility.

In 2012, the ECB defined virtual currency as "a type of unregulated digital money, which is issued and usually controlled by its developers, and also used and accepted by members of a certain virtual community".

According to the definition of the Financial Crimes Enforcement Network (FinCEN; Office of the Financial Crimes Enforcement Bureau of the US Treasury), real currency is "coins and paper money of the United States or any other country that are legal tender, circulate and are usually used and accepted as a medium of exchange in the country of issue. "

However, in 2013, FinCEN departed from these rules - and defined virtual currency as a means of exchange, acting like a currency in some environments, but not having all the attributes of a real currency. In particular, virtual currency does not have the status of legal tender in any jurisdiction [41].

In 2014, the European Banking Authority (European Banking Supervision Authority; EBA) defined virtual currency as a "digital representation of value that is not issued by a central bank or government authority and is not necessarily attached to a fiat currency, but is accepted by individuals or legal entities as a means of payment and can be transmitted, stored and bargained electronically."

As of 2016, more than 24 countries invested in distributed registry technologies (distributed ledger technologies; DLT) with an investment of $ 1.4 billion. In addition, about 100 central banks from various countries of the world participate in discussions on DLT, including the implications the release of digital currency by the central bank [38].

*I*n 2014, the UK authorities commissioned the treasury to conduct a cryptocurrency study to determine the role they could play in the economy of the United Kingdom. The study also had to determine whether the regulatory factor should be taken into account.

The Bank of England (Central Bank of the United Kingdom) in 2016 launched a multi-year research program to study the effects of digital currency issued by the central bank.

The Bank of England has released several research papers on this topic - and announced its intention to make the next version of the basic software infrastructure of the bank compatible with this technology. It is possible that the economic benefits from the release of digital currency using DLT technology may amount to up to 3% of a country's GDP.

Bank of Canada (Bank of Canada; Central Bank of Canada) studied the possibility of creating a version of its currency on the blockchain. To this end, he has teamed up with the country's five largest banks and the consulting firm R3 in the framework of the Jasper project.

In the course of modeling in 2016, the Central Bank of Canada issued CAD coins on the blockchain, similar to Ethereum. At the same time, participating banks used CAD-coins to exchange money, as they do at the end of each working day to calculate their basic accounts. The experiment was considered successful, but before the Central Bank

can decide whether the distributed registry technology is ready for use in the real world, serious testing remains to be done.

In 2016, Deutsche Bundesbank (German Central Bank) tested functional prototypes for calculating securities based on blockchain technologies and the transfer of centrally issued digital coins.

Deutsche Bundesbank and the country's stock exchange operator Deutsche Börse recently announced a research blockchain [39], the technology ofwhich is based on the blockchain from the Hyperledger project.

A natural question arises: will the CBDC be the future for current cash?

In many countries, especially where cash use has declined significantly, central banks are searching for alternatives to physical cash. In these countries, questions such as "Will the payment system still be safe and effective without cash?" Are becoming ever more relevant.

In an attempt to unite the "best of both worlds," central banks are exploring potential and experimenting with CBDC.

Currently, CBDC is defined as an electronic form of central bank money that can be exchanged in a decentralized way, known as peer-to-peer. This means that transactions will take place directly between the payer and the recipient without the need for a central intermediary.

Examples of CBDC are the e-Krona project in Sweden and the Fedcoin concept in the USA, but other countries, such as China, Russia, Canada and the Netherlands, are also exploring the possibilities of DLT and CBDC.

Note that in Sweden it is quite easy to get cash, but it is often very difficult to deposit it in bank accounts, especially in rural areas. So far, Sveriges Riksbank has not decided whether the launch of the national digital currency will be short- term or long-term; However, during the test, experts will decide how best to use e-Krona in order to provide the masses with access to payment facilities guaranteed by the state.

When using e-Krona based on a distributed registry, the balance will be stored in accounts in a central database, however, if you rely on a cost-based solution, e-Krona will look more like current cash, since the value will be stored locally in the app or on a card . Sveriges Riksbank has not yet made any decisions to issue an "e-krone" and identified a number of areas that need to be addressed before making such a decision. One of these areas is the law on the central bank ("Lag om Sveriges Riksbank") - according to which the mandate to issue e-Krona and decide whether the "electronic krone" should be legal tender is in the competence of the country's parliament [43].

Considering the research stage in which the above projects are located, it can be argued that as long as there is enough time to decide on replacing real cash with electronic money in the form of CBDC. However, doubts about whether the DLT-based CBDC application can actually replace real money remain.

Many supporters of electronic payments have long predicted a cashless society. But is it a realistic future, and if so, when? Or is it nothing more than an academic concept that will never be implemented?

In many discussions, this issue comes down to the definition, or, more precisely, to the redefinition of the concept of money. Even Sweden, the country with the lowest dependence on cash in the world, recognizes that there are many reasons for saving (a certain amount) cash and many obstacles for their complete exclusion or replacement.

Therefore, a "cashless society" in its pure form (without cash) seems far, rather theoretical, future.

Annex 2. Glossary

Automatic deposit machine (ADM) – equipment for automatic reception, verification of authenticity (validation), conversion and storage of large amounts of cash. Widely used for making transactions in the retail, transport companies, banks, etc.

Cashless money circulation – movement of money in a cashless form, in the form of funds in bank accounts on demand (deposit money).

Bitcoin – the first decentralized cryptocurrency, created in 2008 by the developer under the pseudonym Satoshi Nakamoto.

Blockchain – continuous sequential chain of blocks (linked list) based on certain rules containing information. Most often, copies of block chains are stored on many different computers independently of each other. Bitcoin nodes use blockchain to distinguish legitimate bitcoin transactions from attempts to re- spend coins that have already been spent elsewhere.

Transaction block – special structure for recording a group of transactions in the Bitcoin system and similar ones.

Note validator – see **Note detector**

Digital currency – a digital representation of value not released by a central bank, credit institution, or electronic money institution, which in some cases can be used as an alternative to money.

Money circulation – the movement of money in cash and cashless forms, ie, a set of operations, the implementation of which leads to the movement of the money supply. The turnover can be divided into cash circulation and non-cash circulation.

Money supply – a set of funds intended to pay for goods and services, as well as for the purpose of accumulation by companies, various organizations and the public.

Note acceptor – a device designed for the operational verification of the authenticity of banknotes, securities and other documents.

Eurozone – a monetary union operating within the European Union (EU), whose member countries transfer to the **European Central Bank (ECB)** all monetary policy authority, including decisions on the size of the issue of banknotes and the level of key interest rate.

European Central Bank (ECB) – the central bank of the **Eurozone** established on June 1, 1998. The headquarters is located in the German city of Frankfurt am Main. Its governing bodies include representatives from all EU member states. The **ECB** is completely independent of the rest of the European Union.

Cash collection – the procedure for collecting and transporting cash and other valuables (important documents, precious metals, bank cards and much more) between different organizations, or between departments of the same organization.

Dual interface bank cards – cards equipped with a built-in chip and antenna that allows performing contact (inserted or read in payment terminals), as well as contactless (spaced across payment terminals) transactions.

Cash center – structural unit that performs banking operations with financial assets in the territorial office of the central bank.

Cryptocurrency – a digital asset developed as a medium of exchange that uses strong cryptographic protection for financial transactions, controls the creation of additional units of assets, and verifies their transfer.

Cash management – a wide area of cash collection, concentration and spending, including liquidity measurement, cash balances and short-term investments.

Cash recycling – technology designed to help banks improve network efficiency and overall cash management, reduce costs and total cost of ownership of equipment, and increase security.

Mining — the computational process of adding transaction records to anopen Bitcoin database of past transactions. This database of past transactions (blockchain) is used to confirm transactions in the rest of the network as completed.

Mobile payment – a cash transaction performed using a mobile telecommunications network device. In mobile commerce, a wireless electronic payment that works with point-of-sale terminals or service points and supports mobile phones, smart phones, and mobile terminals.

Cash circulation – movement of cash, which is served by banknotes and change coins. It is organized by the state in the person of the central bank (or, for the Eurozone, by all the national banks of the countries in the Eurozone).

Remote cash capture – the process is that representatives of various retail enterprises independently through special deposit machines deposittheir daily earnings into a bank account.

Dual interface smart cards have only one chip, but are equipped with both a contact and a contactless interface, so the cardholder can either enter the card into the reader or pass it in front of the RF reader.

Cash-in-Transit (**CIT**) – physical movement of banknotes and coins from one place to another.

Digital currency – type of currency available in digital form. Possessing properties similar to physical currencies, it can allow instant transactions and transfer of ownership, bypassing cross-border rules for different countries.

Central bank digital currency (**CBDC**) – digital currency issued by a central bank of a particular country.

Shekel – 180 barley kernels (about 11 grams). In the ancient world, according to this "scale" it was possible to express the value of any product or service in shekels.

Fiat money – the currency that the government sets as the sole legal

means of payment. The Latin word "fiat" means "decree."

Ether – a cryptocurrency based on an open platform of distributed computing Ethereum blockchain.

Cash-In Box.iQ – cash deposit optimization solution developed by BS/2. It is a reliable deposit machine integrated with the bank's IT system serving a point of sale, as well as efficient and convenient tools for monitoring and controlling the operation of all connected self-service devices.

Cash Management.iQ – multivendor solution is a *.iQ* software family product for automating processes related to the distribution of cash at all cash points developed by BS/2. It allows maintaining the optimal amount of money at all cash points.

Cash Order.iQ – module for forecasting the needs of replenishing or unloading points, planning and placing collection orders for self-service devices and bank branches, setting limits on cash maintenance developed by BS/2. It provides an opportunity to determine the optimal amount of banknotes (by currency and denomination), the frequency of loading cash, and also place orders for the transportation of cash and various valuables for each object.

CashPoint Monitoring.iQ – an autonomous module that monitors cash reception / distribution points (ATMs of most of the leading manufacturers, payment kiosks, bank branches, stores, etc.) developed by BS/2.

CiC (Currency in Circulation) – see **Cash circulation**.

CIT.iQ – module designed for the formation and control of teams of collectors, the formation of route lists of collectors, control of cash delivery to the objects of destination (vaults, bank branches, self-service devices), control of the collection procedure, automatic calculation of the cost of collection developed by BS/2.

CIT Simulator – specialized cash collection simulation tool designed for the convenience of bank employees working with *Cash Management.iQ*.

GS1 – an international non-profit organization that develops and maintains global standards for business communication.

ECDSA (**Elliptic Curve Digital Signature Algorithm**) – digital signature algorithm based on elliptic curves.

Eurosystem – consists of the **European Central Bank** (**ECB**) and national central banks of the **Eurozone**.

FinCEN (**Financial Crimes Enforcement Network**) – Office of the Financial Crimes Enforcement Bureau of the US Treasury.

NFC (**Near Field Communication**) – technology of short-range wireless data transmission, which allows data exchange between devices located at a distance of up to 10 cm.

POS terminal – hardware-software unit, which allows to carry out trading operations, as does an ordinary cash register. In addition to accounting for sales may accumulate other data for their subsequent analysis. It has a user interaction interface to facilitate the search for the right product and its characteristics (price, expiration dates, annotations, etc.), the formation of fiscal checks, change calculation, and performance of various reports.

POS system – hardware complex to automate the work of cashiers based on fiscal registrars. Typically, a POS system includes a PC system unit, a fiscal recorder (FR), a cashier's POS monitor, a cash drawer, a programmable keyboard, a card reader, a barcode reader, and a customer display. All of the above parts of the POS equipment, integrated together, represent a single workplace of the cashier.

SEPA (**Single Euro Payments Area**) – a series of initiatives aimed at introducing common tools, standards and infrastructure for retail payments in euros.

QR code (**Quick Response Code**) – trademark for the type of matrix or two- dimensional bar codes, originally developed for the automotive industry in Japan. A barcode is an optical label containing information about the object to which it is attached.

UnionPay – The National Payment System of China established in 2002 by the Bank Card Manufacturers Association under the auspices of the People's Bank of China.

Vault.iQ – functional module of the *Cash Management.iQ* system. Designed to automate and control the work of the bank vault, allows you to most effectively manage specific internal processes.

References

[1]. Raymond A. K. Cox. "Cash Management". Reference for Business. Advameg, Inc. https://www.referenceforbusiness.com/encyclopedia/Ca-Clo/Cash- Retrieved 14 January 2013.

[2]. Brian Bailey, HEALTH OF CASH 2018. A Study of Cash and Payments in the United States, https://www.atmmarketplace.com/blogs/2018-health-of-cash-study-us-consumers-value-payment-choice/?utm_source=AMC&utm_medium=email&utm_campaign=EMNA&utm_conte nt=2018-12-14

[3]. Cash Management- An Insight, Sai Kumar Jayanty, Anuradha Mallya, Infosys Technologies Limited, https://www.edgeverve.com/wp- content/uploads/2017/03/Cash-Management-An-Insight.pdf

[4]. Адам Смит. «Исследование о природе и причинах богатства народов», М.: Эксмо, 2016. (An Inquiry into the Nature and Causes of the Wealth of Nations, 1776).

[5]. Riksbank predicts Sweden will be 'cashless' within five years, World of Money, December 04, 2018, https://www.reuters.com/article/us-sweden-cenbank-cashless/riksbank-predicts-sweden-will-be-cashless-within-five-years- idUSKBN1O327W

[5]. Cashless payments rising fast in the UK. https://www.atmmarketplace.com/news/cashless-payments-rising-fast-in-uk/?utm_source=AMC&utm_medium=email&utm_campaign=EMNA&utm_content=2 018-12-14

[6]. Koku, https://en.wikipedia.org/wiki/Koku

[7]. Mobile payments users spend more, more often than consumers using traditional payments, https://www.atmmarketplace.com/news/mobile-payments-users-spend-more-more-often-than-consumers-using-traditional- payments/?utm_source=AMC&utm_medium=email&utm_campaign=EMNA&utm_co ntent=2018-12-04

[8]. In the land where mobile payments are king, China says rejecting physical cash is illegal, https://www.scmp.com/tech/article/2177178/china-says-rejecting-physical-cash-illegal-amid-e-payments-popularity

[9]. 3 drivers of a cashless society. By Jason Bohrer, Senior Vice President and General Manager of Secure Card Solutions, CPI Card Group, https://www.atmmarketplace.com/blogs/3-drivers-of-a-cashless-society/?utm_source=AMC&utm_medium=email&utm_campaign=EMNA&utm_conte nt=2018-11-30

[10].Reshaping the future of retail cash management, Micki Seager, https://www.atmmarketplace.com/blogs/reshaping-the-future-of-retail-cash- management/

[11]. Новый продукт Cash-In Box.iQ для самоинкассации торгово-сервисных предприятий, http://www.bs2.lt/ru/novosti-o-produktah/novy-produkt-cash-in-boxiq-dlya-samoinkassacii-torgovo-servisnykh-predpriyatiy/

[12]. Самоинкассация: как эффективно применять автоматические депозитные машины в банковской сфере и розничной торговле http://www.bs2.lt/ru/novosti-o-produktah/samoinkassaciya-kak-effektivno-primenyat-avtomaticheskie-depozitnye-mashiny-v-bankovskoy-sfere-i-roznichnoy-torgovle/

[13]. Как выбрать счетчик банкнот правильно – все виды счетчиков купюр, *http://kassa-spb.ru/blog/kak-vybrat-schetchik-banknot-pravilno--vse-vidy-schetchikov- kupyur/*

[14]. Инструмент моделирования инкассаций – *CIT Simulator, http://www.bs2.lt/ru/novosti-o-produktah/instrument-modelirovaniya-inkassaciy-cit- simulator/*

[15]. Optimizing Cash Flow How to Manage Working Capital, https://www.jpmorgan.com/jpmpdf/1320675884489.pdf

[16]. Strategies for optimizing your cash management, https://www2.deloitte.com/content/dam/Deloitte/ca/Documents/finance/ca-en-FA-strategies-for-optimizing-your-cash-management.pdf

[17]. Payment, clearing and settlement systems in Italy. https://www.bis.org/cpmi/publ/d105_it.pdf

[18]. A comparative overview of the legislations governing the Cash in Transit private industry in the 15 EU members, https://web.archive.org/web/20131030171801/http://www.coess.org/_Uploads/dbsAttachedFiles/Comparative_overview_CIT_legislation_15_MS_full_text_EN.pdf

[19]. Даниэль Фуксон, Современный кэш-менеджмент. 5 требований к системам управления наличностью, http://www.cashmanagementiq.com/ru/novosti/sovremenny-kesh-menedzhment-5- trebovaniy-k-sistemam-upravleniya-nalichnostyu/

[20]: Инкассация и перевозка ценностей (СТО 1.0– 2015) https://www.plusworld.ru/knowledgebase/cat_zakonodatelstvo-i-normativnye-dokumenty/inkassatsiya-i-perevozka-tsennostey-sto-1-0-2015/

[21]. MasterCard: россияне все чаще предпочитают безналичные способы оплаты, https://www.plusworld.ru/daily/platezhnyj-biznes/post-416110/

[22]. UnionPay остается крупнейшей в мире платежной системой, https://www.plusworld.ru/professionals/unionpay-ostaetsya-krupnejshej-v-mire- platezhnoj-sistemoj/

[23]. MasterCard запустит сервис для платежей в режиме реального времени, https://www.plusworld.ru/daily/platezhnyj-biznes/post-410603/

[24]. Payment, clearing and settlement systems in the euro area, https://www.bis.org/cpmi/publ/d105_eu.pdf

[25]. Тенденции и вызовы наличного денежного обращения на современном этапе, ДЕНЬГИ И КРЕДИТ, №1, 2014, http://www.cbr.ru/content/document/file/26737/conf_01_14.pdf

[26]. Наличный денежный оборот в европе и в мире, деньги и кредит, № 5б, 2017, http://www.cbr.ru/Content/Document/File/26415/ionov_05_17.pdf

[27]. The G4S View on the Future of Cash, https://www.thefutureofcash.com/news.aspx?id=14

[28]. WORLD CASH REPORT 2018, http://www.g4scashreport.com/-/media/g4s/cash-report/files/2018-world-cash-report-english.ashx?la=en&hash=0F3BECD46B4820D7FA32112E99252AAB

[29]. Наличное денежное обращение: новый взгляд, https://www.plusworld.ru/daily/cat-cash_circulation/nalichnoe-denezhnoe-obrashhenie-novyj-vzglyad-iz-belorussii/

[30]. Порядок и организация инкассации и перевозки денежной наличности и ценностей в банках Республики Беларусь, https://studbooks.net/1231321/bankovskoe_delo/poryadok_organizatsiya_inkassatsii_perevozki_denezhnoy_nalichnosti_tsennostey_bankah_respubliki_belarus

[31]. Use GS1 Standards to Organize Cash Handling and ATM Processes , https://www.gs1si.org/CashEDI/Doc/use_gs1_standards_to_organize_cash_handling_and_atm_processes.pdf

[32].Cash Management Systems, https://www.bobsguide.com/cash-management- systems/

[33]. Оптимизация рабочих процессов в новой версии Cash Management.iQ 1.08, http://www.news.lt/Novosti-Penki-kontinentai/Optimizaciya-rabochikh-processov-v-novoy-versii-Cash-ManagementiQ-108.im?id=362380&f=c

[34]. Cash Management.iQ: новый механизм прогнозирования спроса на наличность, http://www.cashmanagementiq.com/ru/novosti/cash-managementiq-novy-mekhanizm-prognozirovaniya-sprosa-na-nalichnost/

[35]. Andrew Wagner, Digital vs. Virtual Currencies, https://bitcoinmagazine.com/articles/digital-vs-virtual-currencies-1408735507/

[36]. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System, https://bitcoin.org/bitcoin.pdf

[37]. Virtual currency schemes – a further analysis, https://www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemesen.pdf

[38]. "Directive 2009/110/EC of the European Parliament and of the Council of 16 September 2009 on the taking up, pursuit and prudential supervision of the business of electronic money institutions amending Directives 2005/60/EC and 2006/48/EC and repealing Directive 2000/46/EC, Official Journal L 267, 10/10/2009 P. 0007 - 0017". Retrieved 30 December 2013.

[39]. BoE explores implications of blockchain and central bank-issued digital currency, http://www.econotimes.com/BoE-explores-implications-of-blockchain-and-central-bank-issued-digital-currency-277718

[40]. Joint Deutsche Bundesbank and Deutsche Börse blockchain prototype, http://deutsche-boerse.com/dbg-en/media-relations/press-releases/Joint-Deutsche-Bundesbank-and-Deutsche-Boerse-blockchain-prototype/2819826

[41]. Mining, https://en.bitcoin.it/wiki/Mining

[42]. "FIN-2013-G001: Application of FinCEN's Regulations to Persons Administering, Exchanging, or Using Virtual Currencies". Financial Crimes Enforcement Network. 18 March 2013. p. 6. Archived from the original on 19 March 2013. Retrieved 29 May 2015.

[42]. Common EU rules for professional cross-border transportation of euro cash by road, https://ec.europa.eu/info/about-european-commission/euro/euro-coins-and-notes/euro- cash-transit_en#related-documents

[43]. Lag (1988:1385) Sveriges riksbank, https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/lag-19881385-om-sveriges-riksbank_sfs- 1988-1385

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Since 1999 is employed as the editor-in-chief of the publication «Penki Kontinentai» that specializes in issues relating to technological development of banking and retail.

In 2005-2007 was invited as the scientific expert to the «Branch Optimizer» project carried out by BS/2 in collaboration with Wincor Nixdorf (Germany). Also took part in a number of BS/2 projects including «ASOMIS» (Cash Logistics).