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Impact of Disruptive Technologies on the Sharing Economy

Ford Lumban Gaol, Natalia Filimonova, and Chandan Acharya

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The authors also employed the expert survey method to identify factors and risks affecting the sharing economy at the national level. The following factors have been identified: digital economy development, the openness of citizens and businesses to innovations, consumer mentality affecting behavior patterns, regulatory at the national and local levels, availability of the services, simplicity and quality of the infrastructure, trust, political situation in the country, and digital literacy of the users.

Preface

Disruptive technologies lead to the creation of new markets, serious changes in existing markets, changes in consumer behavior. The concept of disruptive technology originated from the work of Clayton Christensen, in which he defines them as either new combinations of existing technologies, or new technologies that can be used for the creation of completely new products Christensen & Leslie, 2000). Products based on disruptive technologies are usually cheaper, simpler, smaller and more convenient than those based on existing technologies (Tellis, 2006). However, lately it has been pointed out that disruptive technologies are not always cheaper than existing technologies (Sood & Tellis, 2011). Disruptive technology is seen as a special type of technological change that operates through a specific mechanism and has specific consequences. For the successful operation of enterprises, attempts should be made to eliminate the potential unaccounted consequences of technology, and take into account its potential benefits Hall & Martin, 2005).

A large number of disruptive technologies have changed the market and the perception of customers. For example, Uber, founded in 2009, by using a new business model has succeeded in global expansion in more than 75 countries and has made the service more convenient and affordable for consumers (Dudley, Banister, & Schwanen, 2017). Changes in the media space (emerging of Netflix and YouTube) have enabled people to independently choose and control the television content (Van Esler, 2016). There are many examples of successful use of disruptive technologies by the following companies: Amazon (DaSilva, Trkman, Desouza, & Lindic, 2013), Apple, Google, Facebook (Sharon, 2016) and others, based on the use of new business models.

In the scientific literature, discussions are held whether new or existing companies are more efficient in the process of disruptive technologies commercialization. Incumbents with a large operational experience in the existing market have a certain reputation, loyal consumers, but at the same time they do not always recognize disruptive innovations in time (Vecchiato, 2017), and have more difficulties in implementing the organizational changes. One example is Kodak's reaction to the introduction of digital photography technology, which resulted in the loss of about 80% its workforce and reduced market share (Lucas & Goh, 2009). Thus, disruptive technology in itself is not the cause of the collapse of large corporations, but rather the inability to adapt or create new business models for the introduction of new technologies (DaSilva, Trkman, Desouza, & Lindič, 2013).

New firms have advantages over existing ones when commercializing modular and architectural innovation, because of the opportunities for rapid structural changes and rapid response to the emergence of disruptive technologies (Carayannopoulos, 2009). Also, the size of the firm influences on the speed of response to disruptive technologies. Small businesses, with a more adaptive organizational structure, have the ability to make management decisions faster (Garrison, 2009).

Nevertheless, the question of why consumers are starting to use disruptive technologies remains open. Research in the field of IT technology shows that consumers in the choice of disruptive technologies are driven more by the expectation of the effect than the price factor of the transition from one technology to another (Fan & Suh, 2014). On the other hand, in addition to the usefulness and value of disruptive technologies, a strong influence on its acquisition is provided by established relationships and trust between the existing firm and the consumer (Obal, 2013).

Due to the fact that disruptive technologies have high risks and insufficient amount of retrospective information about their use and promotion, it is necessary to carefully assess the potential of disruptive technologies.

In the scientific literature we find various methods and evaluation tools for this purpose, such as business model patterns describing and underscoring business logics of new and unknown markets (Amshoff, Dülme, Echterfeld, & Gausemeier, 2015); a literature-driven method for the forecasting (Dotsika & Watkins, 2017); the SIRS (Susceptible, Infectious, Recovered and Susceptible) epidemic model in RFID technology (Cheng, Huang, Ramlogan, & Li, 2017); technology road mapping based on quantitative and qualitative techniques (Zhang et al., 2016); roadmap combined with expert judgment (Sherif & Khalil, 2008).

Currently there are constant changes: the old services are replaced by new ones, and the trends are changing directions. Edition MIT Technology Review presented a list of ten technologies that in the coming years will have a key impact on the economy and politics, medicine and culture (MIT, 2017). Technologies are developing at a rapid pace, leaving less time for the firms to form reactions to the disruptive technologies.

The target audience of the book, who already have a graduate business or management degrees, should have prerequisite knowledge of the fundamentals of management and economics. The book is targeted at master's or Ph.D. degree students, university teachers, and scientists working in the field of management, business, economics, computer science, and engineering. Moreover, the book will provide insights for the practitioner, analysts, and policymakers involved in the decision-making process.

There are 13 chapters in this book. All of the articles reflect a single focus on how disruptive technology affects the sharing economy.

One of the interesting chapters is "Development of a Quantitative Risk Hedging Mechanism for Mining Companies". This chapter is authored by Andrey Mishin from Vladimir State University, Polina Kisarina from EGAR Technology. Due to the widespread use of algorithmic trading in global financial markets, the problem of writing and testing algorithms has recently gained great relevance. In this chapter, the authors propose an algorithm strategy for trading calendar spreads in gold futures. The strategy is built on the assumption that there is predictable commercial or institutional interest in a particular futures contract. This is the result of seasonal cycles in the inventory and production of raw materials. The price of gold futures contracts with delivery in summer and fall should theoretically be lower than in winter. However, because the regularity in the price of these futures contracts is not immediately visible, it was proposed to use the cost of maintaining the position as a signal. The analysis of the strategy confirms the logic of the calendar spread strategy, which consists in buying futures contracts in the summer months with an expiration date in winter, and exiting these positions in the winter months when the relative price of these contracts is the highest. It is also important to note the assumption that the gold market for the analyzed period is obviously showing a bullish trend. This is probably a consequence of the global demand for metals in unstable markets, so this strategy should be used in growing markets.

The next chapter is "The Problem of Specific Railway Transport Resources Sharing" authored by Pavel Tsypin from Russian University of Transport, Dmitry Macheret from Russian University of Transport, Nadezhda Valerievna Kapustina from Financial University under the Government of the Russian Federation. The desire of entrepreneurs and consumers to minimize the costs of circulation and purchases was investigated in this chapter, which led to the development of a new style of corporate management based on sharing economy principles. This business model is founded on the notion that instead of owning certain items (tools, equipment, and automobiles), customers rent them. It's worth emphasizing that this company model can only exist and grow if modern information technology and Internet resources are used. As a result, the considered business model saves money by lowering the cost of finding information and speeding up the transaction, as well as removing the cost of acquisition and property ownership. The study's goal is to examine and identify the issues surrounding the sharing of economic resources and developing disruptive technologies in the context of transportation, particularly railway transportation. The research employed the following methods: logical-analytical, statistical, dynamic series analysis, technical and economic calculations, and the method of comparisons.

The next chapter is "Methods of Information Processing and Presentation in Peer-to-Peer Online Marketplaces: A Review". The authors of the chapter are Mikhail Monakhov from Vladimir State University, Yuri Monakhov from Vladimir State University, and Andrey Telny from Vladimir State University. This chapter reviews the reputation model used in the online trading platform function. The nature of the communication between agents in social networks depends on the structural properties of the social network itself: whether to provide feedback or not, and how much information the agents can use. Generally, in most models, as long as the agent receives the information within the same time period, the message will arrive at the agent from the same source. Authors believe that it is important to distinguish between the concepts of reputation and trust - reputation is an objective value, but trust is not. Reputation exists in the hearts of many agents, and trust exists in the hearts of a single agent (the subject of trust). Authors conclude that the modeling of network topology and information distribution process plays an important role in the development of methods for evaluating reputation and trustworthiness indicators in social networks.

The interesting chapter is "Users of Sharing Economy Platforms in Russia: Recent Changes in Consumer Behavior". This chapter is authored by Igor Savelev from Vladimir State University and Lomonosov Moscow State University, Marina Sheresheva from Lomonosov Moscow State University, Vera Rebiazina from National Research University Higher School of Economics, and Natalia Naumova from Vladimir branch of Financial University under the Government of the Russian Federation. This chapter looked at how the sharing economy has become one of the most important trends influencing customer behavior in numerous marketplaces. Individuals and corporations can now easily share their idle or underutilized resources and spread the locus of value creation through platform ecosystems, thanks to the rise of online service platforms. According to the findings, Russian users of sharing economy platforms for short-term rental housing want relevant price offers, a variety of hosting proposals, appropriate fees, and website quality, which includes booking convenience, feedback and reviews, quick application processing, and communication with rental property owners. Aside from the aforementioned economic, social, and environmental aspects, individual factors are proposed to be included in the analysis, as they will have a significant impact on defining target groups of Russian users of sharing economy platforms.

The next chapter is "Technological Revolution in Financial Intermediation". The chapter is authored by Galina Panova from Moscow State Institute of International Relations of the Ministry of Foreign Affairs of the Russian Federation, Irina Larionova from Financial University under the Government of

the Russian Federation and Moscow State Institute of International Relations of the Ministry of Foreign Affairs of the Russian Federation and Istvan Lengyel from Banking Association for Central and Eastern Europe (BACEE). The chapter discusses current problems in financial intermediation's creative modernization. Financial innovation has resulted in major systemic and functional improvements in the financial intermediation system in recent years. New technologies open up a lot of possibilities for lowering the cost of data transmission and processing, while also increasing competition and encouraging the development of new financial intermediaries. This chapter examines the debate over the theoretical understanding and analysis of financial intermediation; the impact of disruptive innovations on the economy, with an emphasis on financial sector organizational changes; the use of digital currencies; and the exploration of block-chain technology applications, among other topics. Through the implementation of new business models of modern credit institutions, the chapter explores how innovations have changed the market and consumers' perceptions as they stimulate entrepreneurial innovation and disrupt traditional financial markets.

The next chapter is "Industry 4.0 as a New Disruptive Concept in IT Management and IT Governance: Vision and Future of the Industry 4.0 Concept". This chapter is authored by František Simetinger from University of Economics in Prague. This chapter delves into the notion of Industry 4.0. This topic covers a wide range of topics, making it interdisciplinary. On the one hand, it is based on innovative technologies that have the potential to reduce costs, produce game-changing products and services, or do both at the same time. On the other hand, Industry 4.0 introduces so many innovations and opportunities that it necessitates a fundamental shift in mindset and organizational structure. The important elements of Industry 4.0 are described in the following sections. The technical challenges associated with the technologies, standards, and architectures needed to construct Industry 4.0 solutions were discussed, as well as potential solutions. This concept's organizational characteristics are also discussed. Industry 4.0 projects necessitate a more sophisticated business-IT alignment as well as an open company culture to new ideas. In the context of new discoveries in modern management, viable solutions to these gaps are presented.

The next chapter is "The Algorithm of Semantic Analysis in Disruptive Information Security Systems". The authors as follow Polina Kisarina from EGAR Technology and Andrey Mishin from Vladimir State University. The chapter will be discussed about the most significant disadvantages of DLP-systems used by businesses in international practice. The major structural flaws of these systems have been identified, as well as the factors that influence them. The effect of changes in these variables on type 1 and 2 errors in device operation has been assessed using an experimental setup. We also include the results of the research using algorithms, as well as the impact of the established factors in various business systems in order to enhance the company's economic security.

The next chapter is "Innovative Blockchain Technology Introduction Into the Sharing Economy Subjects' Decision-Making Process". The authors of this chapter are Elena Lazareva from Southern Federal University, Olga Karaycheva from Southern Federal University, Gleb Karaychev from Southern Federal University, Irina Frolova from Southern Federal University. The chapter will be explored about the increasing importance of information technology support of managerial decisions of modern economy subjects, whose preferences are gradually shifting from property to consumption, in the sense of society innovation-digital transformation, defines the significance of study. The aim of the study is to propose ways to incorporate the ground-breaking blockchain technology into the framework of interactions between sharing economy agents, as well as to assess the impact on the transition to a true market economy of equal subjects. The study's target necessitated the completion of tasks such as identifying

economic entities' decision-making algorithms and comparing the benefits of advanced blockchain technology to currently operational knowledge sharing economy platforms. The author's method is unique in that it substantiates the benefits of blockchain technology in approaching the task of building a socially-oriented framework of equitable actors.

One of the interesting chapters is "Development of Sharing Economy: Factors, Effects, Motives of Participation". The chapter is authored by Natalia Polzunova from Vladimir State University, Marina Fedotova from Financial University under the Government of the Russian Federation. This chapter looks at the factors that influence the growth of the sharing economy. The aim of this material is to identify and evaluate the factors that influence the economy's growth. As a result of this research, the framework of factors affecting the growth of the sharing economy has been formalized, and the determinants of socially responsible actions of subjects in sharing economy conditions have been identified. The methods of SWOT analysis were used to formalize the structure of factors affecting the development of the economy of joint use at this time. The findings of the study enable researchers to delve deeper into the workings of the sharing economy. The study's findings will serve as the foundation for future research into the identification of factors that encourage the growth of the sharing economy and the creation of efficient business processes.

The next chapter is "Measuring Impact of SAP R/3 Implementation to Efficiency of Process Business on Paper Manufacturing Industry". The chapter is authored by Ford Gaol from Bina Nusantara University, Yosef Yosef from Binus University. Tanty Oktavia from Binus University, and Tokuro Matsuo from Advanced Institute of Industrial Technology. The goal of this cha is to improve the paper manufacturing industry's sales business operations. Where business operations are still based on manual systems, this study will leverage ERP systems to improve business operations. Exploration methodologies, interviews, and literature studies concerning the development of business processes were used in this study. The findings of this study will be used to develop a new business process design and business process suggestions that are tailored to the needs of an ERP system in the paper manufacturing industry.

The interesting chapter is "Unregulated Use of Blockchain Technologies in the Financial Markets". The authors of this chapter are Nataliya Amosova from Financial University under the Government of the Russian Federation, Anna Kosobutskaya from Voronezh State University, Olga Luskatova from Vladimir Branch of Russian Presidential Academy of National Economy and Public Administration, Russian Federation, and Annie Ravohanginirina from Voronezh State University. The chapter aims to identify the main problems in the use of blockchain technology in financial markets in Russia. The underdeveloped legislation regulating digital instruments requires the identification of risks associated with the use of distributed ledger technology in the financial institutions' activities that threaten their stable functioning. The risks of money laundering and blockchain-based instruments in relation to individuals, financial institutions, regulators, law enforcement, AML/CFT authorities and civil society are examined. The authors study the best practices of financial institutions in the use of blockchain systems and propose measures to regulate the use of blockchain technology in domestic financial markets.

The next chapter is "Dynamics of the Global Value Chains and Disruptive Technologies: Potentials and Trends in Africa". The authors of this paper is Michael Oluwaseun Olomu from National Centre for Technology Management (NACETEM). The chapter discuss the transition to digitalization well underway; another conceptual change is needed to recognize the emerging role of disruptive technology in GVCs. Lower tariffs and rapid technological change have decentralized demand across borders, but some African countries remain marginalized in global value chains. From the perspective of business-model innovation activities in African markets, this study attempts to preliminarily clarify how African

economies and markets extract value from disruptive innovations and generate competitive advantages within the global value chains context. As a result, developing African businesses should not overlook the transformative growth opportunities that exist among emerging economies' vast populations of mass customers and non-consumers.

The next chapter is "Towards a Sharing Economy: Factors, Trends, Risks, and Prospects". The authors of this chapter are Olga Demushina from Russian academy of national economy and public administration, Natalya Buletova from Russian Academy of National Economy and Public Administration, Jun Li from University of Essex, and Mohamed Youssif from Mansoura University. The paper explores factors, trends, and prospects of the sharing economy in economic systems of various types. The research was based on structural and rank analysis developed by the authors. In order to investigate the evolution of the sharing economy sectors and evaluate risks of the sharing economy, the authors employed quantitative (factor analysis, regression analysis, cost recovery method, sensitivity analysis) assessment methods. Besides, the authors applied the qualitative method (expert analysis) to obtain additional information concerning factors, risks, and prospects of the sharing economy. They conducted a descriptive evaluation of the sharing economy factors, risks, and prospects by means of structured interviews. Summarizing the obtained findings the authors made the following conclusions. Sharing economy practices can be considered as a real way to diminish the negative impact of the global environmental crisis because it leads to cost savings through the redistribution of wealth. The level of the sharing economy development in different countries can be measured by the method of structural and rank analysis developed by the authors, it can be presented as a new approach to the typology of countries according to the development of digitization and sharing economy.

The potential benefits of the book lie in the fact that it covers a gap between theoretical knowledge and practical experience, attracts the experience of technology development from different countries, provides a detailed analysis of market development opportunities for entrepreneurs, determines the prospects of disruptive technology development, and finally, motivates researchers to conduct further work in the field.

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Chapter 1
Calendar Spread Hedging Mechanism for Mining Companies

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ABSTRACT

This chapter attempts to answer the question of how much of its current production a mining company should hedge by forward selling by using a model that allows a company to determine the optimal (profit-maximising) hedge. The risk estimation model of company failure is based on the forward price of metals; the miner's operating costs is based on quantitative approach for mining companies. The chapter considers the transition to advanced digital, intelligent manufacturing technologies, robotic systems, the creation of systems for processing large amounts of data, machine learning, and artificial intelligence. The model calculates the present value of future income distributed as dividends in order to determine the value of the company from the perspective of the owner or investor, a multiple of the current value of the product. By simulating the work of several companies working with different levels of forward, it is possible to determine the relative profitability and survival in the market that allows one to determine the optimal hedging ratio.

INTRODUCTION

Due to the widespread use of algorithmic trading in the global financial markets, the problem of writing and testing algorithms has recently become more relevant. Barclays estimates that over the past seven years investors have invested $114 billion in the funds implementing quantitative, or as they are called in the West, systematic strategies. This is 29% of the total amount of funds transferred to hedge funds.

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Barclays predicts an increase in the share of investors preferring quantum funds by more than 5% in 2019. At the same time, according to Global Base Metals Outlook, the majority of Russian mining companies do not hedge their products, including due to the fact that the hedge deprives them of the opportunity to take advantage of a possible increase in prices in conditions of rising metal prices. The use of a hedging mechanism in forwards or futures for even some products would allow, for example, RUSAL to have already concluded contracts for the projected time, regardless of the ban on spot transactions. At the same time, the use of quantitative methods makes it more likely to determine the amount of hedging for companies to make economic decisions.

CURRENT STATE OF RESEARCH IN THE ARIA

Analysis of the current state of research in this area has shown that scientists (theorists and practitioners) who study the hedging of risks, mainly consider hedging currency and market risk (Samoyavcheva, 2007; Khoroshun & Prokopova, 2017; Ilyinova, 2015).

Only Tkachenko and Khusainova (2015) and Mamyasheva (2017) describe the strategy on the example of non-ferrous metallurgy, referring, to a greater extent, to risk hedging through futures contracts.

The issues of risk minimization both on the basis of quantitative (quantum) methods, and in the context of non-standard economic situation in the form of EU and USA sanctions are not considered in any scientific publication.

SCIENTIFIC IDEA, FORMULATION AND SOLUTION OF THE STATED PROBLEM

The use of financial instruments has a long history of being used by mining companies to hedge against serious and adverse changes in the price of the underlying asset, in our case, the price of gold. Since the price of gold fluctuates widely over time and depends on the mood of market participants, the hedging strategy is widely used by gold mining companies using forward contracts. This agreement is concluded between the mining company and the other party (usually the Bank) to sell all or part of the future gold at a pre-agreed price with delivery on the agreed date. Applying this practice, the gold mining company knows with confidence what revenues from future production will be received on the date of expiration of the contract.

The advantage of forward sales for the gold mining company is that it receives a predetermined price for the production of gold, and can fix losses when prices fall. Thus, the company avoids the potential costs associated with financial disasters. The disadvantage of the forward is that with the growing gold market, the future valuation of gold prices, as a rule, is undervalued, and this condition is known as backwardation (a discount compared to the quotation of goods for closer terms). Therefore, in such a situation, gold miners will not be able to get the maximum profit from production, because the forward sale relied on a statement that the prices will fall. In recent years, the price of gold and other metals has changed significantly, in recent years it is constantly growing, which is why futures sales have lost some of their attractiveness.

Another reason for the unpopularity of hedging were the negative publications in the press related to the well-known failures of hedging of a number of companies. Examples of such failures are: (a) Pasminco, which in 2001 suffered a loss of $867 million as a result of failed currency hedging (Dunn,

2001) and (b) Sons of Gwalia, which is the third largest gold producer in Australia in 2004, both companies were driven into bankruptcy because they had committed themselves to deliver more gold than they could produce (Dunn, 2001).

Nevertheless, in both cases, companies should blame themselves for the failure, because they behaved as speculators in the market, and not as mining companies that simply hedged their production volumes. Among other things, shareholders of mining companies do not always positively approve hedging transactions, requiring management to maximize profits in the conditions of growth of raw materials in the market, or resort to transactions using streaming for example Barrick Gold Corporation and other world leaders in the industry. In the context of high gold prices, there is a tendency for companies to mine gold in places with less gold in the ore, which leads to high production costs in contrast to the time with a low price of gold.

In addition, there is a tendency towards companies using higher levels of debt financing in order to proportionally increase the return by increasing the financial leverage or to finance the growth of the company. As a consequence, companies are more sensitive to changes in gold prices, and in theory it is assumed that companies are more prone to financial difficulties if gold prices fall (Collins, 2007). Pegasus Gold Inc. is an example of a company that found itself in such a situation, and when the price of gold fell in 2001 in the conditions of expensive production costs, the company went bankrupt.

Thus, there is a tendency to avoid hedging (in contrast to the increased risk) faced by companies engaged in such practices. Despite perhaps "good times" for miners, the question of how much the company should hedge remains relevant. Known methods of hedging can be divided into two types: simple and complex.

Simple hedging methods are as follows.

- A futures contract as a contract to buy an underlying asset in the future in a specific period at a certain price.
- Option — unlike the futures option owner is not obliged to buy / sell an asset, he only has the right to use this function.
- Forward contract — an over-the-counter instrument, the counterparties of which are most often banks, in all other aspects it has the structure of a futures contract.
- Interest rate swap is a derivative financial instrument, the essence of which is to replace one payment structure with another (for example, receiving a payment at the LIBOR rate).
- Loans issued for inventories are a basic tool for mining companies. Typically, such loans have a lower credit rate, and they are often used by jewelery companies.

Complex methods of hedging, which are most often used for hedging by mining companies:

- Deferred execution account (DEA) — allows clients to enter into spot trades with precious metals with the ability to transfer a position in time without making a settlement on the trade. Such a trade, in fact, is a prolonged forward with an open execution date.
- A spot contract with deferred execution is similar to DEA, but unlike DEA it is a long-term instrument.
- Forward interest rate agreement — used by those who wish to fix the deposit rate to meet any future needs. It can be a lender, whose gold is placed at the time of a sharp increase in deposit rates, but who is interested in fixing these rates for the renewal of contracts in the future, or a borrower

seeking to fix low rates for a future loan before the end of the term of the loan received earlier, because he fears a possible increase in rates in the future (Stulz, 2003).

- Outright — an exchange forward operation, including a premium or discount, in which the exchange rate is set in advance, and the execution of the operation is carried out in a certain short period of time after its conclusion.

Let us dwell on the option schemes used in the gold market. There are three main and very similar: Zero Cost Collar, Bull Put Spread and Bull Call Spread.

Zero Cost Collar is an investment strategy that is commonly used in relation to interest rates, commodities, options and stocks. Investors wishing to protect their profits sell the call option and buy the put option, while borrowers sell the put option and buy the call option. For investors, the costs tend to zero, because for the purchased option, they pay a commission about the same as for the sold option. Depending on the volatility of the underlying asset, the redemption price of the call option varies from 30 to 70% of the established limits (Bartholomeusz, 2004).

Bull Put Spread — this kind of strategy (buying one option and selling another with a higher sell price) is known as credit spread because the amount of cash proceeds from selling put options with a higher strike is more than needed to cover the cost of buying a put option with a smaller strike. The maximum possible profit when using this strategy is equal to the difference between the amount of income from the short put options and the amount of outflow for the purchase of put options. The maximum losses that a trader can incur when using such a strategy are equal to the difference between the option's redemption price and the net loan received. A Bull Put Spread can be realised in in-the-money options or in out-of-the-money options with the same maturity date. Bull Call Spread is the same as the previous strategy, with the only difference being that operations are conducted with call options.

According to the study of the gold industry in Russia, the volume of gold production in Russia increased by 1.7% to 293.3 tons in 2017. Russia's share in global gold production was 8.1% in 2017. The total number of gold mining enterprises in the country increased by 5% in 2017. At the same time, in terms of gold production from minerals in 2017, Russia took the third place in the world ranking for the second year in a row, second only to China and Australia (in 1998, Russia was in the seventh position). Russia's share in global gold production was 254.9 tons, which is equivalent to 8.1% (EY, 2018).

In the Russian market, only two major players take advantage of the use of financial instruments to cover losses in the event of a fall in world prices for raw materials — "Polyus" and Petropavlovsk. Presently, "Polyus" in total hedged about 3.6 million ounces of gold (more than 100 tons). At the same time, the annual volume of gold production in the country it is about 300 tons, and the total amount of hedge in the world, according to Societe Generale and Thomson Reuters GFMS (GFMS, 2016), at the end of September 2015 amounted to 6.2 million ounces (192 tons) — and this was already a third of the volume of «Polyus». The «Polyus», according to our data one of the Russian financial engineering companies was involved in «Polyus» hedging program and they offered «Polyus» a hedge of forward contracts at a price of $1321 per ounce and options zero cost Asian gold collars (or revenue stabiliser). Compared to «Polyus», hedging volumes of other Russian companies are much lower. The second place in the use of hedge tools is taken by Petropavlovsk. According to the audited financial statements of the company for 2016 as of April 26, 2017, Petropavlovsk hedged 547 thousand ounces at $1,253 per ounce for the period 2017-2019 by selling forward contracts.

As a result of the analysis, we came to the conclusion that, although the reasons for hedging are well understood for companies as a whole, these data are not decisive for making a decision to hedge their

positions, since at the same time most Russian companies do not hedge their products, including due to the fact that hedge deprives many of the opportunity to take advantage of possible price increases in the conditions of increased gold prices. According to the Union of gold producers of Russia, the average price of gold in 2019 will remain at $1,270. per ounce, and with the expected cross rate of the ruble to the dollar in the range from 57 to 65 rubles/USD in our opinion, we should not expect an increase in hedge positions from the mining companies.

The scientific idea underlying risk hedging strategies is a trend-following strategy. The optimal policy of risk management can be determined in accordance with various scenarios, which are based on the preferences of the top management of the mining company: either to maximize the company's income, or to minimize the risk of financial losses of the company.

The assumption of the model is that there is no clear decision on value of the costs value associated with the financial difficulties of the company, so the authors consider the company's obligations in the absolute value, which will be a temporary solution under difficult financial conditions of the company. Production costs can be known or estimated by the company based on past periods, and it is possible to use industry averages. The variable is introduced into the model through the future gold price. This is a random variable, its parameters can be determined from historical observations, by assessing the current state or by using other models.

In determining the optimal share of forward contracts the authors consider discrete events simulating the situation of the return of the mining company to its effective indicators. The simulated company makes profits and distributes dividends to shareholders in good years; increases debt when adverse changes occur as a result of lower gold prices and does not seek bankruptcy in the most adverse situations.

The model calculates the present value of future income distributed as dividends in order to determine the value of the company from the perspective of the owner or investor, a multiple of the current value of the product. By simulating the work of several companies working with different levels of forward, it is possible to determine the relative profitability and survival in the market, depending on the volume of production sold under the forward contract. This allows you to determine the optimal hedging ratio.

PROPOSED APPROACHES AND METHODS

Although commodity trading advisors are divided into two main types – discretionary and trend following, in practice the latter prevail. From notes by Campbell (2013), "more than 70% of managed futures funds [estimated] rely on trend-following strategies." Followers of this type of strategy are also known as systematic traders. The keyword here is "systematic". Automated programs scan market data using various technical factors to determine the beginning and the end of a trend at different time intervals. According to Lungarella (Lungarella, 2002), "trading is based on the systematic application of quantitative models that use moving averages, price range breakouts, or other technical rules to give buy and sell signals for a number of markets."

In this investment process, automation is a key factor and discretionary decisions on the investment process are usually taboo. Discretionary traders occupy another part of the split spectrum of commodity trading advisors. About discretionary traders Lungarella (2002) says that "personal experience and decisions are the basis for making trading decisions. They tend to trade more concentrated portfolios and use fundamental data to assess markets, as well as technical analysis to clarify the time frame."

DESCRIPTION OF THE TREND FOLLOWING MODEL

The basic idea behind trend-following strategies is that all markets have a trend at one time or another. Rulle (2003) put forward the idea that "the trend-following program can operate in 80 different markets around the world on a 24-hour basis. Followers of the trend following strategy try to get into long-term trends in the period from 1 to 6 months, when these trends take place."

Trend followers scan the markets by quantitative criteria meant to identify this trend. After its detection, trading begins. A successful trader can limit losses on losing trades and will come out the winner. False trends quickly come to an end and real trends are strengthened. In a sense, this is a distinctive feature among commodity trading advisors. Good managers quickly reduce losses and increase risks on winning trades. In a sense, alpha can come from such dynamic leverage. As Fung and Hsieh (2003) explain, "alpha reflects the ability to balance the right bets and reduce the bad ones, as well as the ability to use optimal entry/exit strategies. Managers who have not been able to take advantage of the good rates and have not shown the ability to avoid losing bets, regardless of the level of the overall profitability of the portfolio should not be encouraged."

CALENDAR SPREADS TRADING

Unlike large-scale commodity trading programs, proprietary futures traders often specialize in understanding the factors that affect the spread between two (or more) months of delivery on a futures contract. This strategy is known as calendar spreads trading. For further clarification: in all commodity futures markets for any commodity, there are usually several prices that depend on the timing of delivery of the commodity. For example, a futures contract for gold with delivery in October will have a different price than a futures contract with delivery in December. Accordingly, futures traders can trade the spread between October and December futures contracts.

Calendar spread occurs when a predictable one-way commercial or institutional interest exists in the form of a specific futures contract: the trader thus picks up the other side of this "flow". Examples of one-way flow occurred during the replenishment and inventory cycles of seasonal inventory, as well as at scheduled times when futures contracts appear in large numbers on commodity indices.

TRADING STRATEGIES

In a situation where futures contracts with delivery for the next month are traded at a discount to contracts for future deliveries, the futures curve is called contango. Moreover, when futures contracts with delivery for the next month are traded with a premium to contracts for future deliveries, the futures curve is called backwardation.

Annual futures curves for gold almost follow the trading volume model. By analogy with other commodities, it can be assumed that the value of summer and autumn futures contracts is traded at a discount to winter contracts. Thus, the markets provide income for the storage of gold. The owner of the vault can buy summer gold and sell winter gold on the futures market at the same time. The difference in price will become income for storage.

Cootner (1967) describes a similar example of the effect of price pressure on grain in futures markets, consisting of the following factors: (1) peaks and troughs in visible grain offerings, (2) peaks and troughs in hedging positions according to data provided by the commodity exchange management to the Commodity Futures Trading Commission (CFTC), and (3) fixed calendar dates that line up with factors (9) and/or (10). In practice, these effects can be monetized through calendar spreads (Cootner, 1967).

Another example of a calendar spread is based on the date of the floating interest rate change in a long-term commodity index swap. Unlike stock indices, one of the unique features of commodity futures index is that according to the rules you need to specify the exact dates on which each of the contracts must be reissued before the maturity of each contract. These rules are called transfer rules. The rules determine when one of the components of an index must be sold and a contract with a longer expiration date must be purchased. Prior to this procedure, speculators on futures contracts, for example, in the wheat market, traditionally have already sold contracts for the next month, making the purchase of the contract for the next month and creating a bearish calendar spread. Later, they spin this position during the time the index rate changes, at best advantageous, but not always as described in Collins (2007).

It is believed that trading robots for futures trading use trend algorithms. Here, the key is to use such algorithms in many and varied markets to reduce overall portfolio volatility. At the other end of the spectrum are calendar-spread strategies. These strategies tend to have limited scalability, but individually can have quite a steady income (Bryant & Mark, 2011).

CALENDAR SPREAD TRADING ALGORITHM

Our strategy began with the assumption that there is a predictable commercial or institutional interest in a particular futures contract. This is the result of seasonal inventory cycles. In our case, it is gold futures contracts (GC:COMEX). The price of gold futures contracts with delivery in summer and autumn should theoretically be lower than the price of gold futures contracts with delivery in winter. However, since the pattern in the price of these futures contracts is not immediately visible, the costs of maintaining the position can be used as a signal.

The cost of maintaining a position in the context of gold is the cost of gold delivery and storage. We assumed that when the cost of maintaining the position (which is the highest quantile relative to the data for the last 30 days) of the gold contract will decline, you need to open a short position. On the other hand, when the cost (as the lowest quantile relative to the data for the last 30 days) of the contract will increase, you need to open a long position.

Gold does not have a predictable demand cycle. At the same time, the price still has noticeable trends that can be applied to the strategy. With regard to the above-mentioned calendar cycle, a potential strategy is the calendar spread strategy, which consists in buying futures contracts in the summer months with an expiration date in the winter, and exit from these positions in the winter months, when the relative price of these contracts is the highest.

The transition of this study into an algorithm is carried out with some assumptions, since the method of obtaining data *data.history ()* available in Quantopian platform is not exactly identical to the research method. The limitations of the method are related to the lack of active historical data on futures expiration when using *data.history()*. Expiration data is required to determine the cost of the transaction costs of storing the underlying asset.

Below is the algorithm code in python:

```
import quantopian.optimize as opt
import quantopian.algorithm as algo
import numpy as np
import pandas as pd
MAX_GROSS_LEVERAGE = 1.0
def initialize(context):
“””
Called once at the start of the algorithm.
“””
# Save the futures contracts we’ll be trading and the corresponding proxies
for the underlying’s spot price.
context.securities = continuous_future(“GC”, offset=0, roll=”calendar”,
adjustment=None)
context.proxy = sid(33837)
# Create empty keys that will later contain our window of cost of carry data.
context.cost_of_carry_data = []
context.cost_of_carry_quantiles = []
# Rebalance every day, 1 hour after market open.
algo.schedule_function(train_algorithm, date_rules.every_day(), time_rules.
market_open(hours=1))
algo.schedule_function(daily_rebalance, date_rules.every_day(), time_rules.
market_open(hours=1))
algo.schedule_function(record_vars, date_rules.every_day(), time_rules.market_
open())
def train_algorithm(context, data):
“””
Before executing any trades, we must collect at least 30 days of data. After
this, keep sliding the 30 day window
to remove the oldest data point while adding the newest point.
“””
ng_contract = data.current(context.securities, “contract”)
ng_etf = data.current(context.proxy, “price”)
if len(context.cost_of_carry_data) < 30:
calc_cost_of_carry(context, data, ng_contract, ng_etf)
else:
calc_cost_of_carry(context, data, ng_contract, ng_etf)
# After collecting 30 days worth of data, group the data points into 5 quan-
tiles.
context.cost_of_carry_quantiles = pd.qcut(context.cost_of_carry_data, 5,
labels=False) + 1
context.cost_of_carry_data.pop(0)
def daily_rebalance(context, data):
“””
Execute orders according to our schedule_function() timing.
```

```
“””
weights = {}
# After collecting 30 days worth of data, execute our ordering logic by buying
low cost of carry contracts.
contract = data.current(context.securities, “contract”)
if len(context.cost_of_carry_data) >= 30:
if len(context.cost_of_carry_quantiles) >= 30:
if context.cost_of_carry_quantiles[-1] == 5 and (contract.expiration_date -
get_datetime()).days > 19:
weights[contract] = -1
elif context.cost_of_carry_quantiles[-1] == 1 and (contract.expiration_date -
get_datetime()).days > 19:
weights[contract] = 1
for security in context.portfolio.positions:
if (security.expiration_date - get_datetime()).days <= 19:
weights[security] = 0
if weights:
leverage_constraint = opt.MaxGrossExposure(MAX_GROSS_LEVERAGE)
order_optimal_portfolio(
objective=opt.TargetWeights(weights),
constraints=[
leverage_constraint
],
)
def record_vars(context, data):
“””
This function is called at the end of each day and plots
the number of long and short positions we are holding.
“””
# Check how many long and short positions we have.
longs = shorts = 0
for position in context.portfolio.positions.itervalues():
if position.amount > 0:
longs += 1
elif position.amount < 0:
shorts += 1
# Record our variables.
record(long_count=longs, short_count=shorts)
def calc_cost_of_carry(context, data, contract, spot_price):
“””
Calculate cost of carry using the following formula:
F(t, T) = S(t) * e^c(T - t)
where F(t, T) is the futures price at time t for maturity date T, S(t) is the
spot price at time t, and c is
```

```
the cost of carry.
"""
current_date = get_datetime()
current_price = data.current(contract, "price")
maturity_date = contract.expiration_date
spot_price = spot_price
cost_of_carry = np.log(current_price / spot_price) / (maturity_date - current_
date).days
context.cost_of_carry_data.append(cost_of_carry) (Petropavlovsk PLC, 2020)
```

CONCLUSION

The scientific idea underlying risk hedging strategies is a trend-following strategy. The optimal policy of risk management can be determined in accordance with various scenarios, which are based on the preferences of the top management of the mining company: either to maximize the company's income, or to minimize the risk of financial losses of the company.

The assumption of the model is that there is no clear decision on value of the costs value associated with the financial difficulties of the company, so the authors consider the company's obligations in the absolute value, which will be a temporary solution under difficult financial conditions of the company. Production costs can be known or estimated by the company based on past periods, and it is possible to use industry averages. The variable is introduced into the model through the future gold price. This is a random variable, its parameters can be determined from historical observations, by assessing the current state or by using other models. In determining the optimal share of forward contracts the authors consider discrete events simulating the situation of the return of the mining company to its effective indicators. The simulated company makes profits and distributes dividends to shareholders in good years; increases debt when adverse changes occur as a result of lower gold prices and does not seek bankruptcy in the most adverse situations.

The model calculates the present value of future income distributed as dividends in order to determine the value of the company from the perspective of the owner or investor, a multiple of the current value of the product. By simulating the work of several companies working with different levels of forward, it is possible to determine the relative profitability and survival in the market, depending on the volume of production sold under the forward contract. This allows you to determine the optimal hedging ratio.

Unlike large-scale commodity trading programs, proprietary futures traders often specialize in understanding the factors that affect the spread between two (or more) months of delivery on a futures contract. This strategy is known as trading calendar spreads. As a further explanation: in all commodity futures markets for any commodity, there are usually several prices that depend on the timing of delivery of the commodity. For example, a futures contract for gold with delivery in October will have a different price than a futures contract with delivery in December. Accordingly, futures traders can trade the spread between the October and December futures contracts. A calendar spread occurs when a reasonably predictable unilateral commercial or institutional interest exists in the form of a specific futures contract(s): the trader thus picks up the other side of that "flow". Examples of one-way flow

have occurred during seasonal inventory replenishment and inventory cycles, as well as on scheduled dates when futures contracts appear in large numbers on commodity indices.

The strategy backtest was performed on Quantopian platform for the period from 01.01.2015 to 12.09.2018. Initial data: gold Futures GC:Comex, position of $1000000. The analysis of the strategy confirms the logic of using the calendar spread strategy, which consists in the purchase of futures contracts in the summer months with the expiration date in winter, and the exit from these positions in the winter months, when the relative price of these contracts is the highest. At the same time, it is worth noting the assumption that the bullish trend is obvious in the gold market for the analyzed period. This is probably a consequence of the global demand for metals in unstable markets, so this strategy should be used in growing markets.

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Chapter 2
The Problem of Specific Railway Transport Resources Sharing

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ABSTRACT

The desire of entrepreneurs and consumers to reduce the costs of circulation and purchases led to the development of a new form of business management based on the principles of the sharing economy. This business model is based on the fact that instead of owning certain things (tools, equipment, cars, housing), consumers use them on a rental basis. It is worth noting that this business model can exist and develop only with the use of internet resources and modern information technologies. Thus, the considered business model reduces costs by reducing the cost of searching for information and the speed of the transaction, as well as by eliminating the cost of acquisition and property possession. The aim of the study is to analyze and identify the problems of sharing economic resources and emerging disruptive technologies on the example of transport, especially railway transport. The following methods were used in the research: logical-analytical, statistical, methods of dynamic series analysis, methods of technical and economic calculations, the method of comparisons.

INTRODUCTION

The development of the theory and methodology for assessing the transport resources use efficiency, including the use of shared consumption model are discussed in the works of the following authors: Maikova (2019), Sabitov (2019), Hartmann (2019), Kelly (2017), Shor, Walker and Lee (2015), Mach-

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eret (2014, 2018), Pittman (2002), Sotnikov, Levin and Alexeyev (2007), Shapkin and Obukhov (2015), Ryshkov (2014), Voznesenski (2018), Khusainov (2017).

The following methods were used in the research: logical-analytical, statistical, methods of dynamic series analysis, methods of technical and economic calculations, the method of comparisons.

One of the modern management forms and methods is the application of the sharing economy concept, the key principle of which is "to use, but not to own". The sharing economy is an entirely new model of business process organization, fundamentally different from traditional approaches.

The model of shared consumption was first described in detail by R. Botsman and R. Rogers (2010). Shared consumption is an economic model based on the collective use of goods and services, rent and barter instead of ownership. Sharing of various resources can be practiced: housing, cars, parking, equipment, tools, knowledge and skills. Maykova (2015) showed in her previous work that technologies development, the spread of the Internet and social networks accelerated shared consumption development, while environmental problems and the economic crisis motivated people to participate in this model.

Since the advent of natural exchange, people shared with each other the benefits available — invited relatives and friends to visit, allowed to spend the night and for a while shared things that they did not use themselves. Shared consumption is not a completely new model of business organization, however, thanks to the widespread development of the Internet, it has received a new, larger implementation. We all know from our childhood rental of sports equipment in holiday homes, skate rentals at the rink and skis in parks. However, all this exchange was limited to the place of our stay or the communication circle of a particular person.

With the development of technology, society has returned to this practice — but now the exchange of things and services is not limited to a narrow circle of communication of a particular person, and has grown to the scale of the world. This phenomenon was called shared consumption and became a new socio-economic model that radically changed our consumption of goods and services (Sabitov, 2018). The modern model of sharing certain goods and objects involves the use of Internet resources, which removes the restriction of access to the service only to local residents. Moreover, now it is not necessary to visit the rental office to rent a car. It has also become virtual and if you have a free car in the vicinity of your stay, you can use it by making a deal for rent in a few seconds using your smartphone.

Researchers at the University of Utrecht in the Netherlands identified two groups of reasons for sharing: external (economic benefit, practical need, receiving praise) and social (helping another person, meeting new people). It is also worth noting that the interest of participation increases, if the action does not involve monetary costs, especially when exchanging inexpensive things such as a screwdriver or braid. As the cost increases, the desire to share decreases, while the higher education level of the exchange participants increases the probability of participation. Hartmann (2016) also noted that women are more likely to share consumption than men.

The basic principle of the sharing economy development is that it is more convenient and profitable for the consumer to pay for temporary access to the product than to own it. The sole ownership of both expensive property (yachts, airplanes, country houses, foreign residences) and not so much expensive (car, sports and construction equipment) in the modern world becomes costly and often unprofitable. Quite expensive is the purchase and maintenance of the car, which is used on average only 3% of the time, which, in general, is quite irrational. In addition, it is worth noting the change in the model of consumer behavior in society. The market for renting cars, houses, machinery, equipment, etc. is developing quite intensively, and not because people can not buy this property, but simply because there is no place to store and are not sure that this property may be needed later. Kelly (2017) noticed in his previous work

that consumers want freedom, new experiences and travel around the world, while property becomes a real ballast that requires constant attention and maintenance costs.

Thus, sharing is becoming an important trend, and perhaps a new paradigm for the economy and society development (Shor, Walker, Lee, 2015). First and foremost, it applies to resources such as information, environmental assets and public relations that need equitable distribution, cooperation and horizontal interaction for better use (Lapidus and Macheret, 2011).

At the same time, the emergence of resource-sharing technologies as a paradigm requires that traditional economic activities (in which the use of resources is usually based on private ownership and profit-making) will adapt to the resource-sharing technologies. This can result in expanded understanding of sharing, going beyond the idea of equitable sharing of production of the product not focused on profit, but covering economic entities interaction, allowing to get additional benefits each of them and to increase public welfare.

It is also worth noting that the development of the shared economy is influenced by two main factors: the trust of consumers and service providers, as well as a change in consumer thinking. According to April Rinne (2019) a change of thinking and the emergence of consumer confidence requires time.

One of the main characteristics of entrepreneurs operating on the principles of the sharing economy is their explosive growth. For example, the mobile operator of the taxi service Uber Technologies Inc. (established in 2009) plans to hold an initial public offering (IPO) in 2019 and its value is estimated at $ 120 billion (April Rinne, 2019). However, it is worth noting that some of them suffer quite large losses. For example, the Chinese Bicycle rental company Ofo is on the verge of bankruptcy, as 11 million users demand to return the deposit (Chinese Ofo byking, 2018).

The aim of this paper is to study the problem of economic resources sharing and emerging disruptive technologies on the railway transport example.

MAIN PART

Methodology

On the basis of the above, taking into account the railway transport specifics, a study of technologies for sharing economic resources, including disruptive technologies, was conducted. In this case, the following were done:

Firstly, identification of the features of sharing resources on the railway transport.

Secondly, development of the railway transport sharing resources types classification.

Thirdly, study of the stages of sharing resources development in the evolution of the global railway system and related technologies, including disruptive technologies, taking into account different countries features.

Fourthly, international experience analysis in implementing the principle of non-discriminatory access to the transport infrastructure.

in the fifth, analysis and forecast of changes in the technology of freight cars using in the course of the railway transport reform as a new round of disruptive technology.

in the sixth, an assessment of the potential economic effects of the freight cars shared use technology implementation.

RESULTS

In this context, it is of special interest to consider the shared use of railway transport resources. Railways are an important branch of the modern economy, experiencing a period of "innovation Renaissance", and having a clear vision of global development for the period up to 2050 (Lapidus, Macheret, 2011).

The international Union of Railways has defined strategic principles for the global railway system development for the period up to 2050: sustainability, safety, productivity, connectivity, interoperability, competitiveness and attractiveness.

In the context of the topic discussed in the article, attention should be paid, first of all, to the connection, which means the elimination of borders between carriers belonging to different modes of transport and involved in the implementation of multimodal transport and interoperability – ensuring unhindered interaction of different railway systems, including the unhindered crossing of railway rolling stock of these borders, the possibility of using the same rolling stock on the infrastructure of different railway systems. This possibility can equally be interpreted as the use of different railway infrastructure for transportation in the same rolling stock. In other words, interoperability is closely linked to the sharing of infrastructure and rolling stock in the global railway system, and connectivity is linked to the sharing of infrastructure and means of transport in multimodal transportation.

It is obvious that the successful solution of these problems will contribute to the growth of competitiveness and attractiveness of railways in the long term.

Thus, the joint use of railway transport resources meets the long-term objectives of this industry development on a global scale.

At the same time, the volume of railway transport traffic in the world tends to increase (Global rail transport – global trends, 2017). Railways play a leading role in the transport systems of the USA, Russia, China and a number of other countries. In the EU countries, the program Shift2Rail is implemented, aimed at switching traffic from less environmentally friendly and more dangerous vehicles to the railways.

The most important and at the same time specific railway (as well as other modes of transport) assets, are infrastructure and rolling stock.

It should be noted that railway transport is characterized by the following features:

- focus on goods and passengers mass transportation, which determines the need for the sharing use of the same infrastructure and vehicles by different economic entities and individuals;
- closest technological relationship (among all transport modes) between infrastructure and rolling stock, which limits the free access of the rolling stock owners to the infrastructure and competition between them (Lapidus, 2011).

The following types of railway transport resources sharing can be distinguished:

- Sharing use of infrastructure (use of railway infrastructure for the traffic of trains belonging to different owners);
- sharing use of train space for the traffic of cars belonging to different owners);
- sharing cars (usage of cars in the interests of various cargo owners and passengers).

At the same time, the cars capacity, the trains weight and the infrastructure use intensity are increasing, which increases the relevance of ensuring their effective sharing.

Over the past half–century, the world's largest railway system – the USA first class railways - has increased the average car load capacity by more than 1.7 times and exceeded 90 tons; the average net weight of the train has increased more than twice, and exceeded 3200 tons. The load intensity, which characterizes the intensity of infrastructure use, has increased by more than 5 times and is more than 17 million ton-kilometers per kilometers of operational length (AAR. Railroad Facts, 2016).

In Russia, the load density has more than tripled over the same period and exceeds 27 million ton-km/km, the net weight of the train has more than doubled and exceeded 2,400 tons.

Similar trends exist in China, Canada and other countries.

The problem of railway infrastructure sharing use in the first years of the railways development tried to solve using the model of roads and canals sharing use.

The very first railways in England and the United States were built on the basis of the "highway" or "canal" model. At the same time, it was guaranteed – sometimes even through special legislation – that the railway track was open to any user who paid the road toll and complied with the rules of the railways using. This model of vertical integration, combined with competition, appears to have worked well as long as the transport of goods by horse. However, after they began to use locomotives, it turned out that the use of the railway at the same time vehicles with horse and locomotive traction is quite difficult and inefficient. As the owners of the railroad were generally the only owners of locomotives, the "highway" model was fairly quickly abandoned, and the railway became integrated monopoly company, which owns the tracks and operates trains (Sotnikov, Levin, Alexeyev, 2007; Burns, 2010).

Further development of the railway industry and the formation of railway networks from separate railway lines, led to the problem of sharing use of the freight cars fleet by different railways.

At first, cargos were accepted for transportation only within one railway. If necessary to send the cargo to another railway, it was reloaded at the docking station from the cars of one railway to the another railway cars. This significantly slowed down the cargo delivery and increased its cost, and with the growth of volumes and range of transportation has become a serious barrier to the goods traffic. It was required to develop mechanisms for the sharing use of rail car fleet.

The first option was the delivery of cargos in the car belonging to the departure railway company to the destination station with the subsequent urgent car return to the owner. The corresponding decisions were made at the first General Congress of representatives of Russian Railways, held in St. Petersburg in 1869. At that time there were 25 Railways in Russia, some of which were private, others belonged to the state. In accordance with the decisions of the Congress, the Russian railway network was divided into five groups of railroads, within each group non-transshipment was organized. Cairns (2013) noticed in his previous work that the car with the cargo, which passed to the "foreign" road, had to return to "its" road on the "urgent return» principle. For late return significant fines were charged.

This made it possible to get rid of the cargos overload at the docking stations, but not yet providing for the sharing car fleet use and caused unjustified cars mileage. After all often "others" cars went empty in the same direction in which "ours" cars were loaded. It should be noted that this technology has proved to be disruptive for the cars transshipment business at the docking stations, but in general has increased the railway transport efficiency. This is an example of Schumpeterian "creative disruption".

The next stage was the sharing use of the rolling stock by railways on the basis of the "equivalent exchange" principle.

The basis for this principle implementation was the "General agreement between the Russian Railways on the freight cars mutual use" signed in 1889. The agreement provided for:

- depersonalized (i.e. shared) use of cars of different owners already on all the railway network (instead of within separate groups of roads);
- the equivalent exchange between railroads on genera of universal cars (covered, platforms, etc.) with the permission of replacement of separate genera of cars by cars of other kind;
- uniform penalties in the presence of debt on cars transfer on inter-road butt transfer points (Cairns, 2013).

Cars had to be transferred only in good condition. This was controlled by their inspection at the transfer points. Special wagons were still to be returned on the basis of the "urgent return" principle.

To ensure consistency in compliance with the equivalent exchange and balance of rolling stock, an annual census of cars was introduced, held on 1 may. On its basis was established the systematic presence of cars on the roads, had been made the balance of the fleets and the terms of the redistribution of cars on the roads, which claimed the regular Congress of the Railways representatives. In the early 1890-ies in the Department of Railways of the Russian Ministry of communications was created the division of the movement, carrying out accounting and rolling stock transfer regulation between Railways on the basis of equal exchange implementation.

The system of equivalent cars exchange had essential advantages in comparison with the principle of their urgent return. A significant intensification of the use of cars was provided by reducing their empty mileage, thereby reducing the cost of transportation, which means that tariffs could be reduced. In other words, an objective basis was created both to improve the production and financial performance of Railways and to reduce the tariff burden on producers.

Thus, in Russia, the system of shared use of rolling stock on the basis of an equivalent cars exchange between the railroads was implemented in the 90-ies of the XIX century, in France - since 1920. According to the agreement on mutual use of cars adopted then, each railway had the right to contain in the park any cars, both "ours" and "others", but their quantity shouldn't exceed the established share of the general park. For the maintenance of excess cars, in excess of this share, the railroad paid a fine in favor of those roads that worked with a deficit of the Park. At the same time it was obliged to hand over excess cars. For management of this system the special body – "the Main cars accounting office" which daily considered cars existence as a whole on a network and on each railway - was created, it made the calculations between railroads connected with cars use and an exchange of them. A solution to this problem had its specificity in the US, Germany and other countries (Cairns, 2013).

Thus, the creation of a system of freight cars shared use on the railway network required significant legal and organizational changes, in fact, the creation of a new institution of the car fleet shared use, destroying old inefficient practices of using cars and increasing the efficiency of freight rail transport for both cargo owners and for the Railways themselves.

By integrating separate railways in the national railway network the cars fleet sharing use problem, it would seem, has lost its significance. But the railway industry reform in the late XX-early XXI century, which in the European Union was carried out through the vertical separation of transportation activities and infrastructure, and in Russia through maintaining their vertical integration, made the sharing use of cars fleet and infrastructure by various companies very important.

Non-discriminatory access to infrastructure, ensuring its sharing use by different companies, is one of the world's recognized principles of modern railway policy. In different countries its implementation has certain features.

In the United States, the practice of one railway company's trains on lines owned by other companies has been in effect for a long time, but in most cases the guest company cannot collect or spray cargo shipments (i.e., carry out "local work") on "foreign" lines (Lochman, 2013). This right is not granted on a commercial basis, but is established by legal acts, and therefore it is called regulated (Khusainov, 2016).

In the European Union, free access to railway infrastructure is a fundamental transport policy principle. Lochman (2013) showed in his previous work that theoretically, any organization that meets the operational requirements and safety conditions can obtain a license for the right to pass their trains on any line. All EU directives in the field of railways are aimed at the consistent development of competition based on ensuring non-discriminatory access of independent operators to the railway infrastructure. Voznesenski (2018) have shown in his previous work that such access opens up better prospects for innovative development, increased flexibility and efficiency of transport services.

In Russia, the only national freight railway carrier – JSC "Russian Railways" - is also the owner of the main railway infrastructure. However, it does not actually have freight cars, which belong to numerous operator companies. Each operator carries out commercial dispatching of its fleet on the basis of contracts concluded with specific shippers. All this, although it creates competition, also has negative economic consequences.

Firstly, the percent of empty cars run is high. Myerson and Satterthwaite (1983) showed in their previous work that over the past ten years, it has consistently exceeded 40% (in 2018 – 40.1%), while at the turn of the 1980s-1990s was only a little more than 30%.

The long-term dynamics of freight cars empty run share on the Russian Railways is shown in table. 1.

Table 1. Long-term dynamics of freight cars empty run on Russian Railways

	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2018**
Freight cars empty run, %	32,2	41,1	39,5	39,6	40,5	40,7	40,1

Secondly, the empty car that is moved through the network on the basis of the individual contract of a particular provider with particular senders is processed in the route (at marshalling yards) the same as a loaded car, with a similar cost shunting means and associated costs.

On the one hand, the separation of freight cars from infrastructure and transportation activities and their transformation into the ownership of operator companies, managed by the commercial dispatching technology within each company, contributed to the inflow of investment in the cars purchase and the solution of the rolling stock shortage problem that existed for many decades. On the other hand, the wagon business of the infrastructure owner carrier (JSC "Russian Railways") was destroyed and additional costs (associated with the transition from the general cars fleet management technology to the technology in the conditions of many owners) arose.

Since each car belongs to a specific owner, empty cars can no longer be managed as an impersonal loading resource, they need to be processed at stations individually. As a result, according to the study performed by Shapkin and Obukhov (2015), the number of shunting movements increased by 8-10 times, and the time spent on shunting work per train – by about 7 times when private cars were supplied for

loading and unloading. But shunting is one of the most expensive operations of the railway transportation process (Groves, 1973). Therefore, the corresponding increase in operating costs is very significant.

The growth of the car fleet and the complication of working with it in the presence of many owners, in the conditions of existing infrastructure constraints have led to the fact that one of the fundamental economic laws – the law of diminishing returns - has appeared on the railway transport. Its essence is that the marginal productivity of additional units of production resource decreases with the increase in the amount of this resource, if the number of other production resources is invariable (Samuelson and Nordhaus, 2010). Russian statistical Yearbook: statistical compendium, 2018). On the Russian Railways, this was manifested in 2010-2013 by a decrease in car productivity and freight train speeds (Macheret and Ryshkov, 2014). Macheret (2012) noticed in his previous work that although subsequently, due to the improvement of the transportation process technology and changes in the operating situation, the improvement of the rolling stock use quality indicators was resumed, the negative impact of these factors on the organization of transportation and the economy of the transport industry remains.

At the same time, attempts to return to the centralization of car fleet management have shown their inefficiency and inconsistency with market conditions. Voznesenski (2018) showed in his previous work that the solution may be the organization of "smart" market for rental cars that would provide "an opportunity for the exchange of obligations between operators for the relief of the negative consequences of the cars fleet management decentralization". It is necessary to take into account the fundamental provisions of the economic mechanisms theory (Groves, (1973), Myerson and Satterthwaite (1983)).

It is necessary to consider the possibility of adaptation to the specific conditions of the railway industry of sharing use technologies used in other modes of transport, especially automotive.

The increase in the number and change in the quality of the cars, as well as changes in the structure of demand for road passenger and freight transport have led to a significant increase in the number of cars on the roads. Rustichini and Satterthwaite (1994) showed that since the beginning of the XXI century the number of trucks and public buses in Russia has increased by about 1.5 times, and cars – more than 2.3 times. The result was an increase in road congestion and a decrease in vehicles use efficiency.

According to the forecast presented in the concept of the updated "road map" "Avtonet 2.0" until 2035, in 15 years the main players of the car market will not be automobile concerns, but information suppliers on cars boards. Initially, this document was aimed at the development of unmanned transport. However, recently actively developing business models based on the principles of the sharing economy have set new goals and objectives. It is predicted that by about 2030 using a smartphone it will be possible to order a transport service anywhere and at any time. Therefore, the need for personal ownership of the car will disappear. For its successful development this market will require digital services that will help make road transport more convenient and accessible to the public. (Road map of the National technological initiative "AutoNet 2.0", 2018)

One of the most striking examples of the sharing economy is the Uber taxi service. The main purpose of this service was to motivate the population to refuse the use of personal road transport in favor of taxis. The next stage in the development of sharing use in road transport is the emergence and dynamic distribution of car-sharing services, which is a short-term (per-minute) car rental, also in order to encourage consumers to abandon their own cars.

It seems that the car-sharing technology could be an effective tool to reduce the empty run of freight cars in railway transport. Of course, it is impossible to set a goal to return its percent to the indicators of 30 years ago: the economic conditions have changed radically. But even a reduction in the percentage of empty mileage by 4-5 points would have a significant economic effect due to:

- operating costs reduction and, accordingly, the freight transportation costs;
- reduction of required investments in the car fleet renewal;
- reduction of required investments in the locomotive fleet and railway infrastructure facilities for the cars placement and maintenance.

Investigating the problem of efficiency of shared consumption of resources, it is advisable to assess the potential effect of freight cars fleet shared use technology introduction.

As noted above, the main result of freight cars shared use technology introduction on the operation of Railways can be a decrease in the share of empty cars mileage in the total mileage, which on Russian Railways exceeds 40%, and, for example, on US Railways is even greater (Khusainov, 2017).

At the same time, the ratio of empty cars run to loaded cars run, which is usually used to assess the impact of empty run on the cost of freight, is even greater (table.2) (Smekhova and Kiporov (2003), Smekhova and Kozhevnikov (2015)).

Table 2. Dynamics of empty cars run coefficient to loaded cars run on the Russian Railways, %

	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2018**
Empty cars run / Loaded cars run, %	47,5	69,8	65,3	65,6	68,1	68,6	66,9

As can be seen from the comparison of the data in table 2 and table 1, the empty to loaded mileage ratio not only exceeds the share of empty mileage in General, but is also more volatile. This is due to the peculiarities of the calculation of each of these indicators.

The share of empty freight cars mileage in the total mileage αemp is determined by the formula:

$$\alpha_{emp} = nS_{emp} / (nS_{lo} + nS_{emp}) *100\% \quad (1),$$

where nS_{emp} – empty cars run, measured in car-kilometers;

nS_{lo} – loaded cars mileage.

Empty cars run ratio to loaded α^{lo}_{emp} is determined by the formula:

$$\alpha^{lo}_{emp} = (nS_{emp} / nS_{lo}) * 100\% \quad (2)$$

Accordingly, these indicators are related to the ratio:

$$\alpha^{lo}_{emp} = \alpha_{emp} / (100 - \alpha_{emp}) * 100\% \quad (3).$$

With the growth of the cars empty mileage share in the total mileage, the ratio of cars empty mileage to loaded increases simultaneously both by increasing the numerator of the expression (3) and by reducing its denominator. Conversely, when the proportion of empty cars run in the total run decreases, the

empty run coefficient of empty cars run to the loaded one decreases simultaneously both by reducing the numerator of the expression (3) and by increasing its denominator.

Therefore, changes in the cars empty run ratio to loaded are always more significant than changes in the share of empty cars run in the total mileage.

The effect of varying the empty cars run ratio to loaded on the freight cost is determined by the fact that changing the empty cars run all the pricing measures, adopted for the analysis of operating expenses and freight transport cost calculation, except the number of consignments, also change, namely:

- cars-kilometres;
- cars-hours;
- locomotive-kilometers;
- locomotive-hours;
- brigade-hours of locomotive crews;
- electricity or fuel consumption for train traction;
- gross ton-kilometers of cars and locomotives;
- shunting locomotive-hours.

At the same time, Smekhova (1997) noticed that the nature of the change of the meters is direct, i.e. their values grow with an increase in the empty cars run coefficient to loaded (though slowly), and decrease with its decrease. This explains the nature of the dependence of the freight traffic cost on the ratio of empty cars run to loaded, which in general is expressed by the formula:

$$C_{lo} = a + b * \alpha^{lo}_{emp} \quad (4),$$

Where C_{lo} – freight transportation cost,

a, b – constant dependence parameters determined for specific conditions by the method of expenditure rates (Smekhova and Kiporov (2003), Smekhova and Kozhevnikov (2015)).

Having determined the dependence of the freight traffic cost on the ratio of empty cars run to loaded, you can calculate the coefficient of influence of this indicator on the freight cost.

The coefficient of influence is calculated as follows. First, the formula (4) is substituted by a certain basic value of the empty cars run coefficient to the loaded one and the corresponding value of the freight transportation cost C^0_{fr} is calculated. Then the empty cars run coefficient to loaded increases by 1 percent point and a new freight transportation cost value C^1_{fr} is determined in the same way. After that, the coefficient of influence K_{inf} is calculated:

$$K_{inf} = | (C^0_{fr} - C^1_{fr}) / C^0_{fr} | *100\% \quad (5)$$

It shows how many percent will change the cost of freight when changing the empty cars run ratio to loaded by 1 percentage point. This indicator varies significantly depending on the operating conditions, the implementation of structural changes in the railway industry, and also varies significantly by types of traction ((Khusainov (2017), Smekhova and Kuporov (2003), Shapkin and Obukhov (2015)).

Smekhova (1997) noted that under the conditions of operation of the general cars fleet, the cost of shunting locomotive hours per 1000 cars-kilometers of empty cars were taken three times less, compared with loaded cars. At present, as noted above, this distinction has been virtually eliminated. But when

implementing freight cars shared use, the specific costs of shunting locomotive hours for processing empty cars can again be reduced, which will give an additional effect. Taking into account the noted, the coefficient of influence of empty cars run ratio to loaded on the freight traffic cost can be taken at the maximum level of 0.2.

The following model can be used to estimate the impact of the change in the empty cars run to loaded on the freight transport cost:

$$\Delta C_{fr} = (C^{0}_{fr} * \Delta\alpha^{lo}_{emp} * K_{in}) / 100\% \quad (6),$$

Where ΔC_{fr} - change in the freight cost, rubles/ton-kilometer;

C^{0}_{fr} - the basic cost freight value, rubles/ton-kilometer;

$\Delta\alpha^{lo}_{emp}$ - change in the ratio of empty cars run to loaded, percentage points;

K_{in} - the coefficient of influence of this indicator on the freight cost.

The corresponding savings in operating costs of railway transport ΔE will be:

$$\Delta E = \Delta C_{fr} * Pl \quad (7),$$

Where Pl - freight turnover of railway transport, ton-kilometers, net.

A reduction in the empty cars run will reduce the need for rolling stock for the same volume of freight turnover. Taking the reduction of the car fleet proportional to the reduction of the total car-kilometers (which is true in the case of the unchanged average daily mileage of the car), the reduction of the car fleet (Δn) can be determined by the formula:

$$\Delta n = n_{0} / (1 + \alpha^{fr}_{emp} / 100\%) * (\Delta\alpha^{fr}_{emp} / 100\%) \quad (8),$$

where n_{0} is the base value of the freight cars number;

$\Delta\alpha^{fr}_{emp}$ – change of coefficient of empty cars run to loaded, percentage points.

The corresponding reduction in the need for investment in rolling stock (ΔKcar) can be determined by the formula:

$$\Delta Kcar = \Delta n * Y_{car} \quad (9),$$

where Y_{car} – the average price of a freight car, rubles.

With the reduction of the rolling stock required for the implementation of freight turnover in accordance with the demand, the need for locomotives (train and shunting) and the infrastructure necessary for the movement and maintenance of cars and locomotives will also be reduced. Consequently, there will be savings in investment in the purchase of locomotives and infrastructure development. A detailed assessment of these savings requires rigorous, complex calculations beyond the scope of this study. For the integrated assessment the multiplier M can be used, which shows the ratio of savings in investment in the locomotive fleet and infrastructure development to savings in investment in the car fleet. Then the total saving of capital investments as a result of reduction of empty cars of cars (ΔK) can be defined by the formula:

$\Delta K = \Delta K_{car} * (1+M)$ (10).

The multiplier value can be taken at least 2.

Savings of the reduced costs as a result of reduction of empty run of freight cars (ΔCr) can be determined by the formula:

$\Delta C_r = \Delta E + \Delta K * i_n / 100\%$ (11),

where i_n is the rate of interest on capital.

The results of the assessment of the freight cars empty run reduction potential effects on the Russian Railways based on the implementation use of car fleet shared use technologies (in 2018) are given in table 3. The rate of interest on capital in the calculations adopted at 10%.

Table 3. Potential effects of freight cars empty run reduction on the Russian Railways as a result of application of car fleet shared use technology

Reduction of ratio of empty cars run to loaded, percentage points	Savings, billion rubles		
	In operating costs	In investments	In reduces costs
1	3,13	39,97	7,13
2	6,27	79,94	14,26
3	9,40	119,92	21,39
4	12,54	159,88	28,53
5	15,67	199,86	35,66

The results of the calculations show that the potential effects of the freight car sharing technology use are significant, even if the result is to reduce the empty-to-loaded ratio by only 1-2 percentage points. It should be noted that the prevailing component of the effect – saving capital investments – will be deferred, especially in terms of saving capital investments in the locomotive fleet and infrastructure. However, in the context of ensuring the long-term effective development of the railway industry, such savings are extremely important, as they will help to free up investment resources for the implementation of innovative projects necessary to ensure the strategic competitiveness of railways (Macheret and Izmaikova, 2016).

CONCLUSION

As a result of the search for minimizing the costs of entrepreneurs and reducing the cost of consumer purchases, a new form of business management, based on the principles of the sharing economy, has appeared. This business model is based on the fact that instead of owning certain things (tools, equipment, cars housing), consumers use them on a rental basis. A distinctive feature of this business model is that it can exist and develop only with the use of Internet resources and modern information technologies. Therefore, the considered business model reduces expenditures by reducing the cost of searching

for information and the speed of the transaction, as well as by eliminating the cost of acquisition and property possession.

The paper discusses the distinctive characteristics of railway transport resources shared use, clarifies the possible forms of railway transport resources shared use, identifies the stages of development of resources shared use in the railway industry and corresponding technologies, including disruptive. The paper analyzes the world experience in the implementation of the principle of non-discriminatory access to transport infrastructure and presents a forecast of changes in the technology of freight cars use in the reform of railway transport as a new round of disruptive technology. Also the assessment of potential economic effects from realization of freight cars shared use technologies was carried out.

Thus, the creation of effective technologies for the sharing use of rolling stock, as well as infrastructure, is of great economic importance for the railway industry. Although these technologies, by reducing the overall need for the car fleet, can obviously destroy the business of some relatively less efficient operator companies, as well as companies for the car production and repair, the overall result will be an increase in the efficiency and competitiveness of the railway industry and industries that actively use railway transport.

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Chapter 3
Methods of Information Processing and Presentation in Peer-to-Peer Online Marketplaces: A Review

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ABSTRACT

In e-commerce, buyers do not have enough information about the products and services provided. In some industries, retail trade has been completely supplanted; offline trading floors have become essentially pick-up points. Therefore, online marketplaces have a disruptive effect on traditional trade. Features of the online environment often encourage consumers to take additional risks (e.g., to buy a product or service having only its virtual representation available). A system of trust is formed to streamline the virtual interaction of sellers with buyers and stimulate regulations in the purchase/sale, since the usual regulatory mechanisms and rights do not work here. The electronic market in general can break down. Such a problem can be eliminated by introducing mechanisms of trust and reputation of buyers and sellers to each other. The chapter provides an overview of the ways of presenting and processing information in the systems of reputation and trust that function on online trading sites on the social networks of the internet.

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INTRODUCTION

In e-commerce (online and cloud trading platforms, digital commerce websites such as Aliexpress.com, Ebay.com, Avito.ru, etc.), buyers do not have enough information about the products and services provided. In some industries, retail trade has been completely supplanted; offline (retail) trading floors have become essentially pick-up points. Therefore, online marketplaces have the disruptive effect on the traditional trade. Features of the online environment often encourage consumers to take additional risks, e.g. to buy a product or service, having only its virtual representation available. A system of trust is being formed to streamline the virtual interaction of sellers with buyers and stimulate regulations in the purchase / sale, since the usual regulatory mechanisms and rights do not work here (Diekmann & Przepiorka, 2017; Jabeen, 2018; Musial & Lopez-Loces, 2017).

The electronic market in general can break down (degrade) (the theory of the "market of lemons" (Akerlof, 1970)). Such a problem can be eliminated by introducing mechanisms of trust and reputation of buyers and sellers to each other (Adamopoulou & Symeonidis, 2014; Dellarocas, 2003; Gomrokchi, 2009; Neystadt, 2018; Wang & Wang, n.d.; Yan & Holtmanns, 2008).The following problems arise during the introduction and implementation of trust systems:

- to what extent the trust mechanisms will be socially fair (Hoff & Bashir, 2015) ;
- what risks exist when using them, what are the possible abuses and vulnerabilities and how to protect against them (Dellarocas, 2004) ;
- how trust indicators change dynamically in different environments (Zacharia et al., 2000) ;
- how to present the factors used by people to make trust in real life and how to collect data to automate the decision of placing the trust onto new subjects (Balaji et al., 2017).

The chapter provides an overview of the ways of presenting and processing information in the systems of reputation and trust that function on online trading sites on the social networks of the Internet.

SOCIAL NETWORK AS AN INFORMATION AND COMMUNICATION PLATFORM FOR ONLINE TRADING

A social network is a structure consisting of a set of agents (users) and a set of relations between them - a set of connections between agents. Agent - subject / node / user, understood as an independent source of information. A social network of the Internet (online social network) is a platform, an online service, or a website designed to build, reflect, and organize social relationships between agents (Social networks and virtual network communities, 2013).

Online Social Network is considered in this work as an information and communication infrastructure supporting the electronic trading platform (ETP). ETP allows to combine suppliers and consumers of goods and services in a single infocommunication and trading space and provides ETP participants with services that increase the efficiency of their business, that is (Adamopoulou & Symeonidis, 2014; Dellarocas, 2003; Gomrokchi, 2009; Neystadt, 2018; Wang & Wang, n.d.; Yan & Holtmanns, 2008):

- to receive information on the organization of interest working on the ETP;

- to search for buyers and consumers of goods and services that are placed on the platform and in the network;
- to advertise their products in a large-scale virtual information space;
- to implement a system of trade and procurement activities;
- to analyze various activity indicators of organizations in the topics of interest;
- to implement secure electronic document flow between users of the platform.

Information resources of social networks can be presented as follows:

- either as informational messages published by agents on their page;
- or as comments and emotional assessments of messages posted by other agents on the page of the agent-author of the message.

Authors distinguish the features of social networks, essential for analyzing trust between agents, such as (Novikov & Chkhartishvili, 2004):

- the presence of agents' own opinions and the possibility of change of said opinions under the influence of other agents;
- the difference in influence and trust of some agents for others;
- the existence of "residual" influence in the chain of social contacts;
- the existence of agents with the maximum "influence";
- the ability to localize groups "by topical interest";
- the existence of external factors of influence;
- the impact of the structural properties of social networks on the dynamics of opinions, i.e. if the agent has an increased number of connections, therefore, on the one hand, he has more opportunities to influence the entire network through his environment, and on the other hand he experiences increased levels of vulnerability to external influence;
- clustering effect (the higher the link density of the neighboring active agents, the greater the likelihood of a change in the state of the associated agent);
- the possibility of forming groups, coalitions;
- the activity experienced as the purposeful behavior of agents.

Creating models and algorithms for assessing the reputation of agents and trust between them is one of the key tasks in the construction and effective operation of ETP. When solving it, problems arise related to the properties of the information and communication system under consideration, namely:

- the lack of authentication of data on the social network site, often agents provide false information about themselves;
- closedness of the system - procedures for administering and managing a social network are usually hidden from users;
- information retrieval is difficult, i.e. it is sometimes impossible to obtain complete information about the topology of the social network.

The mathematical model of a social network is a graph, the nodes of which are considered agents, and the edges are information and communication links between them. Let us list the essential properties of the graph:

- large scale;
- heterogeneity - vertices usually have a varying number of adjacent edges;
- dynamics of nodes and connections - changes in the number of nodes and connections in the system over time;
- the presence of groups of nodes "weakly linked" between each other.

The nature of the communication between agents in social networks depends on the structural properties of the social network itself: whether it provides for feedback, how much information is available to agents, how information can be distributed over the network.

To analyze the interaction of agents, we consider two communication models: the Shannon-Weaver model and the De Fleur model (Havra, 2011). Note that the models in our view do not take into account the influence of the technical means of the information dissemination environment, the type of transmitted messages and the internal properties of agents.

For example, consider two sites - a standalone blog and a distributed blog structure (LiveJournal, Twitter, VKontakte). Standalone blog is a website of a blogger (seller) on the Internet, where a blogger posts informational messages - "posts". The purpose of "posts" is to convey information to his audience. Note that standalone blog can only be indirectly represented as a social network. It is possible to measure the audience of a blogger using a site attendance counter. A feature of such a social network is the lack of feedback between the source and the addressee. Users can not leave their opinions, expressed in one form or another, about a particular message, on the site of the blogger. The distribution of information in such a social network is described by the Shannon-Weaver model. The elements of the model include:

- information source - blogger, as a shaper of informational messages;
- transmitter (sender) - the site on which messages are posted (published) in one form or another (depending on a particular web application);
- the channel that carries this message to the users, - the Internet;
- the recipient is a network user "connected" to this blog.

Note that the message sent by the source and the message that reached the recipient, in general, have an unequal content. The inability of the participants to realize that the message sent and the received message do not always coincide is a common cause of the communication difficulties.

Theoretically, in the model, the source selects a message from a finite set of available messages. The purpose of the source and, accordingly, communication, is to reduce the level of uncertainty (entropy) in the recipient. The message selected by the source through the transmitter is sent over the channel (as a signal) to the receiver. The receiver converts the received signal back to the message (decodes the received signal) and then it is retrieved (interpreted).

The Shannon-Weaver model is essentially a centralized graph, where the central node is the agent who posted the information in the blog. Further information is accepted by all other agents on the network. Fundamentally the following facts can be stated: information transfer is unidirectional and has no feedback. The message arrives to agents from the same source, none of the agents will receive information

earlier or later than another agent, provided that the agents receive information in the same period of time. We emphasize that in a model, nodes can have connections between themselves (physically, agents who receive information can communicate).

In another type of social network, communication between agents is different. Such networks have a feedback mechanism - with the help of comments or reposts, agents can convey their opinion on the information posted in the post to the source of information. Agents can publish their opinions about a specific message on the site of the agent-information source.

Communication interaction in such a social network is described by the De Fleur model. The elements of the model (information source, transmitter (sender), channel, receiver) coincide with elements of the Shannon-Weaver model. The feedback mechanism allows the transmitter (sender) to adapt its messages for the communication channel to increase the efficiency of information transmission and increases the likelihood of correspondence between the sent and received value.

In this model, it is proposed to distinguish between first-order feedback, when the sender can receive a feedback message during the impact (relative to the social network - this is an emotional approval, represented as a "like"), and a second-order indirect communication, obtained from evaluating the impact results (for example, commenting on informational message). In the process of transmitting information about the event from the source to the final destination, the message may be distorted by noise: agents in the chain distort the received information. However, with the help of a feedback mechanism, the source can control the quality of the information received by the addressee.

The strength of the connection (the influence on each other) between agents can be considered using the matrix of pairwise comparisons (Mui et al., 2002). The ultimate goal of comparing agents is to find out their rating among the set in question.

Agents Trust and Reputation

In Social Network Analysis (Gibb, 1978), trust is an open and positive relationship between people, containing confidence in the decency and goodwill of another person with whom the trustee communicates in one way or another. Relationships such as openness, confidence, willingness to rely, competence, goodwill, honesty and predictability are noted. Economists use a more formal definition: trust (Mui et al., 2002) is the subjective expectation by agent A of future behavior of agent B based on the history of their interaction. The degree of trust is the subjective conincidence of beliefs (Castelfranchi & Falcone, 1998).

When modeling and assessing indicators of trust in social systems, it is necessary to take into account the dependence on the subject, multiple personality facets, dynamics and interaction history (Bentahar et al., 2009; Dellarocas, 2003; Fullam et al., 2005; Hendrikx et al., 2015; Yan & Holtmanns, 2008).

Reputation is the prevailing public perception of an agent based on certain criteria and on the basis of its past actions observed by a certain group of subjects (team, community). It can also be informally defined as an opinion about a person or a group of people or organization. Reputation is formed by such criteria as personal characteristics, achievements in any spheres of public life, a certain image and demonstration of a certain behavior, and serves to determine the most likely behavior in the future.

By "a group of subjects" (a "team") (Ermakov et al., 2005) we mean a collective (a union of people engaged in joint activities and having common interests) that is able to achieve the goal autonomously and in concert. Essential in the definition of a team are two aspects. The first is that the final result of a joint activity is a unifying factor for the team. The second - autonomy and consistency of activities

- means that the behavior of community members is as expected by other team members (Novikov & Chkhartishvili, 2004).

It is important to separate the concepts of reputation and trust - reputation is an objective value, but trust is not; reputation exists in the minds of many agents, trust exists in the mind of a single one (subject of trust); you can trust both on the basis of reputation, and vice versa.

Trust in social networks, when agents are virtual, and likely unfamiliar with each other, can only be provided through information and communication interaction. Because of this, trust can be assessed by perusing information published by agents. Thus, the problem of trust between users of a social network is treated as a problem of the reliability of the information source.

INFORMATION RELIABILITY

The problem of reliability, as one of the basic properties of the quality of information, is relevant in the light of the critical role that information plays in the knowledge-based economy and big data (Madnick, 2009). Scientific publications present a wide range of methods for assessing and increasing information reliability, which is not a separate characteristic, but identifies risk factors that directly influence decision making (Nicolaou & McKnight, 2006; Orr, 1998). It is noted that the significance of a correct assessment of reliability is constantly increasing due to the fact that the severity of the consequences of erroneous decisions based on inaccurate data can vary: from temporary, financial and reputational losses to conflicts and wars (Redman, 2001).

The development of global information networks and the absence of regulatory standards with respect to transmitted data leads to a decrease in the level of information reliability. There is a growing need to detect invalid data. An essential aspect is the inability of modern search technologies to extract data of "dubious content" (Rieh & Belkin, 1998).

Reliability of information (Batini & Scannapieco, 2006) is understood as its quality and suitability for use in decision-making management tasks. The quality of consumer information is the most significant factor in predicting consumer behavior (Francalanci & Pernici, 2004). Factors affecting judgments are determined by the parameters of informational messages, characteristics of sources, knowledge, situations (subject area) and objectives of the analysis (Jeong & Lambert, 2001; Rieh, 2002). Despite the fact that there is a wide range of studies on various aspects of the reliability of information, there remains a need for a methodology for assessing the accuracy criteria common to various types of information systems (Huh et al., 1990; Kahn et al., 2002; Katerattanakul & Siau, 1999; Weidema, 1996).

Recently, there has been an increase in the number of applications using Internet information sources, which often generate conflicting information about the same object or phenomenon. There are "data conflicts" (Lee et al., 2002).

Reliability of information is sometimes understood as data accuracy. At the same time, there is also a contextual quality (reliability) of informationwith respect to the task (Müller et al., 2012; Strong et al., 1997; Wang & Strong, 1996). A person is characterized by a dual process of cognition, which makes it possible to simultaneously assess both objective and contextual attributes of information reliability (Stvilia, 2008). Here we note that the same information resource may have an acceptable level of confidence for some contexts, but it may be unacceptable for others. Unfortunately, existing metrics of data reliability are generally obtained neutrally, without taking into account the specificity of the context.

This demonstrates the need to revise data reliability indicators and measurement methods to include context assessment.

The quality of the data source is essential to the overall level of confidence. This is especially true for systems that require initially "uncertain" data (Watts et al., 2009).

We highlight the following criteria for assessing the reliability of information:

- authenticity (conformance to reality), utility (conformance of data to user requests) and content (Agmon & Ahituv, 1987);
- accuracy, completeness, consistency and timeliness (Blake & Mangiameli, 1994);
- accuracy, completeness, consistency, relevance, accuracy, timeliness, accessibility, interpretability and consistency (Cong, 2007; Fox, 1994);
- accuracy, completeness, consistency and value (Blake & Mangiameli, 2011).

The authors note that obtaining accurate measurements and economically feasible assessments of the reliability of information is difficult because of the complexity of information systems and the subjective nature of the quality of information.

The main limitation of the existing approaches to assessing the data reliability is their specialization in specific issues or conditions. Methods for assessing the reliability of information can be divided into two groups: heuristic (used by auditors) and formal (operational models of information resources, information processes and information systems (Adir & Shankaranarayanan, 2007).

For example, approaches to assessing the reliability of data in databases are based on the analysis of relations and consider the database as an entity-relationship graph, where direct and indirect relationships correspond to the paths in the graph (Nuray-Turan, 2013). While common errors in the database, such as non-existent indices, can be detected and corrected using traditional data cleaning tools, many semantic errors remain that cannot be eliminated within the framework of known technologies. The problem can be solved by a matrix of quality (reliability) in data mining tasks (Maimon et al., 2001).

The search for unreliable data even in the presence of their highly structured and connectedness (as, for example, in the relational representation) requires the use of a set of methods, such as data profiling, fuzzy analysis, intellectual analysis (Ballou & Pazer, 1985). Note also that the correction of inaccurate data that has already been entered into the database and used, causes considerable difficulties in connection with the "distribution of unreliability".

The general model for assessing the reliability of data in decision-making systems should reflect the study of data flows with the measurement of a number of parameters at the stages of collecting, entering, processing, storing, transmitting and presenting information. The model should give an idea of possible errors in the set of intermediate and final results. In this case, the propagation and change of errors of various types should be taken into account (Stvilia et al., 2007).

Managing the level of reliability of information is impossible without first establishing a connection with the source of information, the context and carrying out its structural analysis (Mezzanzanica, 2011). Data sources containing sequences of events can be modeled using finite state machines. Data consistency rules can be expressed by formal methods and automatically checked on, both before and after performing certain actions. A formal procedure for managing the data reliability during all stages of the information life cycle should convert confidence indicators into estimates of additional uncertainty.

Thus, an integrated approach to data reliability should integrate data quality assessment and data architecture into a single structure with a series of steps, procedures, checklists and tools and take into account technologies, processes and user problems (Nelson et al., 2005).

MODELS OF TRUST AND REPUTATION

To assess the reputation (credibility) of a blogger, there are web applications, for example, Wildfire Social Media Monitor (https://wildfiresocial.com/) and FollowerWonk (https://followerwonk.com/). Furthermore, blogger influence indicator can be calculated automatically, for example in LiveJournal (as an indicator of social capital). Nevertheless, the question is always open whether these indicators really assess the actual "influence" of a post on a social network. Can you trust him? How is the outlook of the agent taken into account if he simply searched for a fragment of a record in a search engine?

In the simple additive model (Gubanov, 2009), the reputation value of the analyzed agent is determined by the sum of positive and negative feedback from other agents (likes, voting, comments). The counting method is primitive, the reputation value is estimated roughly. The advantage of the model is the transparency for the user. The model can be used to assess trust as one of the indicators (not the most significant).

Another approach is based on the following concepts (flow model). Community trust relationships are modeled by a graph whose agents are vertices, and edges are built on the basis of certification (opinion) by each community member of those agents that it trusts. In the simplest case, trust from the "community core" (a group of agents with the highest trust) to other agents is determined by the presence of a path on the trust graph from the vertices of the kernel to the top of each agent, using the transitive property of trust. An approach based on calculating the "trust flow" through a graph is proposed. The main idea of this approach is to find the maximum flow through the graph, after which all those agents whose vertices receive a non-zero "trust flow" as input will be trusted.

In the other model (the Marsh model (Gubanov, 2009)), a set of trust variables is introduced and their way of combining to get one value of the trust index in the range [-1; 1], where -1 is total distrust, and 1 is absolute trust. Each of the trust variables depends on the context and time. Three types of trust are defined: basic - in all contexts, common - between two agents in all contexts, and situational - between two agents in specific conditions. These values of the trust variables are used to calculate the risk associated with a particular situation and perceived awareness of the target agent (trust) in a given topic. The following is an algorithm for making decisions about interacting with an agent based on a certain threshold.

The model (Richardson et al., 2003) assumes a method for calculating the agent's belief in statements made by agents - sources of information. This approach relies on the fact that the agent's belief in an assertion must be a function of his confidence in the sources of the statement. To calculate the trust for an unknown source, the transitive property of trust in the network is used. The generalized value of trust depends on the totality of the paths between this agent and other agents that have personal belief values in the statement in question. For acyclic graphs, the generalized value will be calculated as follows: all paths between the agent and others with a personal belief value in the statement are listed, the trust value in the statement for each path is calculated using the concatenation function of trust in the path and the value of the final node, the result will be obtained as a trust value for the final node.

The algorithm of distributed "voting" of network participants regarding each other's reputation by evaluating the success of file transfer is described in (Kamvar et al., 2003). Each node stores a history of interaction with other nodes and evaluates trust as the difference between successful and unsuccessful file transfer attempts. This algorithm is based on the transitivity of trust to participants. The authors consider the case when the network may be a team of attackers who evaluate each other highly and lower the trust estimates for the rest of the network. To solve this problem, an algorithm for modifying the vector of opinions is proposed. Using this algorithm it is possible to weaken the initial trust in the attackers.

In the model Sporas (Histos) (Zacharia & Maes, 2000) the following restrictions are introduced:

- the value of the reputation of the agent can not be less than the value of the reputation of the novice;
- adversaries cannot make "empty transactions", appreciating each other positively, and thereby increasing their own reputation;
- the reputation value is limited from the top and depends on the past activity of the agent;
- the time period for calculating the reputation is also limited.

In the model, only the latest score between the two agents is calculated. In addition, for agents with high reputation, its value after evaluation changes much less than for users with low reputation. The model can work with both direct and indirect ("witnessed") information. Applicability of the models depends on the connectedness of the graph.

The game-theoretic model (Schillo et al., 2000) is designed to assess trust in scenarios where the result of the interaction between two agents can be represented by a binary value ("good" or "bad"). Agents are involved in a multi-stage game, at each stage there is a phase for choosing a partner. Each agent receives information about the results of the game in which he plays, as well as the results of games played by a certain subset of neighbors. Each agent uses a directed trust graph in which it is represented by the root vertex, witnesses are represented by child vertices, and the edges carry information about witness observations. Obviously, the testimony information may be unreliable. However, the model assumes that agents do not lie, but can hide positive information.

In the role model (Carter, 2002), the reputation of an agent is based on the fulfillment of roles assigned to him by the community: if the community believes that the agent performs its function, then its reputation grows, otherwise it falls. Since each community has its own set of roles, reputation only makes sense in the context of a particular community.

A community is a multitude of agents sharing information. Five agent roles are defined in the community:

- *social information provider*, who must regularly contribute new knowledge, i.e. recommendations about his friends to the community; each recommendation provided at a certain point in time has weight - the power of the recommendation;
- a *user* who must use the system regularly. The satisfaction value is calculated as the number of user operations during a certain period of time divided by the total number of operations performed in the system during the same period;
- a *content provider* that should provide their (expert) knowledge to the community. The value of satisfaction with a role is reflected in the quality of informational messages provided by users, which is determined by the proximity of his subject to the interests of the author of the message;

- *an administrator*, collecting information about the quality of the system;
- *a "centennarian"* long-living agent that maintains reputation over time in order to promote the longevity of the system.

The user's overall reputation is calculated as a weighted sum of the degree to which each role is performed. The weight value is community specific. The reputation value for each agent is calculated centrally. This value is global and used by all agents.

Model (Sabater & Sierra, 2002) is intended for use in e-commerce systems in which social relations play an important role between individuals (agents). This model takes into account not only direct and testimonial information, but also information about social relations (competition or cooperation) of the interacting parties. To calculate trust, first of all, the results of direct interactions are taken (that is, the promised in the contract is compared with the final price, delivery date, quality, etc.). If there were no interactions in the past, then the agent's reputation is used . The model includes three specialized types of reputation, depending on the source of information:

- *reputation from witnesses* who interacted in the past with the agent. The main problem here is that witnesses can lie or hide information Moreover, witnesses can express their opinions based on only the same event, and also witnesses can be influenced by each other. The choice of witnesses is as follows: there is a set of all witnesses, a relationship graph is built on this set, the most connected components of the graph are identified, for each component there are "bridges", or if there are none, nodes with a maximum degree of connectivity (the point is to choose representatives for each group). Further information is requested regarding the reputation of the target agent from the selected nodes (representatives). Confidence in the information provided regarding the target agent depends on the social relationship between the witness and the target agent, for example, the following fuzzy sets and an odd rule are used to calculate trust: if the cooperation between the witness and the target agent is high, then the trust of the agent to the witness information about the target agent weak;
- *reputation from neighbors*, which is based on information about the neighbors of the target agent and the social relations between the target agent and its neighbors. For example, if a target agent's neighbor has a reputation for fraud, and they are in a cooperative relationship, then it is likely that the target agent is also a fraud;
- *systemic reputation*, which is based on information on institutional structures and on the role played by the target agent in the relevant institutional structure.

Model (Abdul-Rahman & Hailes, 2000) is specifically designed for use in online e-commerce communities. The model discusses direct trust, as trust in an agent based on direct experience, and trust in a witness, as trust in the ability of a witness to give good recommendations. The value of direct trust for an agent is represented by qualitative levels: "very reliable", "reliable", "unreliable", "very unreliable". The agent maintains a history of interactions for each partner. When combining recommendations, the recommendations of agents with a similar point of view in this context are recognized as more significant. The value of trust is a weighted sum of recommendations.

Model (Bobrikov, 2010) suggests that user reputation can be increased by using different types of messages between agents. The model uses the "opinions" of users about each other. Schematically, the calculation of reputation can be represented as follows. The system keeps statistics on the exchange of

messages. Based on it, the "opinions" of agents about each other are calculated. Opinions aggregate information about messages of different types into a single value. Then it is the opinions used to calculate the reputation of all participants. Among the features of the model, we highlight the following:

- the value of reputation does not depend on its own programs in favor of others in order to exclude the possibility of "cheating". According to the transitive property of information transfer in the model, the transfer of reputation in the system will occur not only in connection with the direct transaction between agents. Theoretically, with any change in reputation, the reputations of all agents should also change;
- in principle, the system allows the user to become "negative" in the event when he had received a certain number of negative messages. In this case, its function as an agent with trust (influence) becomes meaningless. When a reputation becomes negative, its distribution ceases. Thus, the influence of agents on the system decreases as its reputation decreases and reduces to zero when the reputation is less than or equal to zero;
- in order for a novice to begin to influence the reputation of others (to act as an influential user), he must receive a non-zero initial rating. That is, the system needs to charge beginners a bonus. Further change in his reputation is possible due to the activity of others.

PRELIMINARY CONCLUSIONS

There is a conventionally basic (generalized) model for assessing the reputation of agents. It is based on informational influence in a social network, which reflects the degree of agents' trust in each other. The model is as follows. There are many agents in the selected social network community. Agents in the network through the exchange of messages affect each other, the nature of the influence is given by the influence matrix, where the non-negative elements of the matrix indicate the degree of trust of one agent to another. If one agent trusts another, who trusts the third, then this means that the first indirectly affects the third, i.e. "chains" of indirect influences are possible. At the initial time, each agent has an opinion on a certain issue. The opinion of all network agents reflects the column vector of non-negative initial opinions. The exchange of opinions of agents leads to the fact that the opinion of each agent changes under the influence of the opinions of agents that this agent trusts. The elements of the reputation vector are the sum of the influences of each agent (Gubanov et al., 2009; Wu et al., 2015).

There are two approaches to the formation of a reputation model: linear and non-linear (transitive). In the case of a linear approach, the contribution of the indicator (degree) of the trust of the donor agent (influenced) to the reputation of the recipient agent (influencing) does not depend on the current reputation of the donor agent. The non-linear approach assumes that the contribution of the donor agent to the reputation of the recipient agent depends on its own reputation as the donor agent.

The greater the reputation of the donor agent, the greater the influence. The linear approach is simple to implement and widely used. But the results he gives are not very consistent with an intuitive understanding of reputation. In addition, linear reputation is much easier to "wind up." The nonlinear approach gives more correct results (Zacharia et al., 2000).

Reputation characterizes each agent (user) selected for a specific subject area of a community (team). It makes sense to talk not about absolute, but about the relative reputation of agents. The reputation of an agent is the sum of "reputation transfers" from other agents. Reputation can be increased by "system

bonuses" or reduced by "system penalties". The reputation of an agent is higher, the more donor agents he has and the more positive informational messages from them. The contribution to the reputation of the recipient agent depends on the current reputation of the donor agent. The greater the reputation of the donor agent, the greater the influence.

By participating in the exchange of messages, the donor agent, as a result of the "recalculation", "transfers" some share of his reputation to the recipient agents. Such a share of reputation may be limited to a certain limit, which depends on the value of the reputation indicator of the donor agent, but does not depend on the number of informational messages with which it responds to messages from sources - recipient agents.

MODELING

When developing methods for evaluating indicators of reputation and trust in social networks, network topology (the structure of information relations between agents) and the modeling of information distribution processes play an important role.

From the point of view of topology, a social network belongs to the class of complex networks that have non-trivial topological properties. In (Dorogovtsev & Mendes, 2003; Newman et al., 2006) one of the accepted classifications of topological models of networks is given. Their characteristics are described: the distribution of the degree of connectivity of nodes, the cluster coefficient and the average length of the network path.

In (Ferrara & Fiumara, 2011), a study of the topology of popular social networks is carried out and the search for the most adequate topological model is carried out. The reviews (Ahn, 2007; Kumar et al., 2010; Liben-Nowell & Kleinberg, 2007; Mislove, 2007) highlight trends in the analysis of the topology of social networks:

- a study of the topological characteristics of social networks;
- a research into the evolution of social networks;
- the research and development of methods for calculating the characteristics of large-scale social networks, solving the problem of obtaining a representative sample.

Social networks are often referred to as "scale-free" (SF) () and "small-world" (Newman, 2000) networks.

The most well-known structural problem in social networks is the problem of finding communities - structurally related groups of agents. Some methods for detecting communities are proposed in (Chakrabarti et al., 2000; Chi, 2007; Lin, 2008). The problem of detecting communities arises in a static network, where the network changes slowly over time, and in a dynamic network, in which the structure of the network is developing rapidly.

Social networks can be considered as a system that allows you to disseminate information. Analysis of the dynamics of such interaction is a complex problem. The propagation model can be found in (Kempe et al., 2003). The problem of impact analysis is relevant in the context of identifying the most influential members of communities.

Let us briefly describe the classes of models of influence (Gubanov et al., 2010).

A threshold model is a model in which there is a threshold value or a set of threshold values used when changing states. Classical models with thresholds were developed to model collective behavior (Granovetter, 1978).

Leakage and contamination patterns (Breer, 2009) are a popular way of studying the dissemination of information and innovation in social systems. To describe the processes of information dissemination in social networks, the latter can be viewed as a complex adaptive system consisting of a large number of agents, the interaction between which leads to large-scale, collective behavior that is difficult to predict and analyze. Cellular automata are sometimes used to model and analyze such complex systems. The article (Zhang, 2005) presents the Markov model, which studies the influence in a team (group of agents). The proposed model is a dynamic Bayesian network (DBN) with a two-level structure: the level of individuals (the actions of each agent are simulated) and the level of groups (the actions of the group as a whole are simulated).

Mutual Awareness Models (Gubanov et al., 2010). There is an agent that is part of some social network. The agent is informed about the current situational context (actions and views of other agents, environmental parameters - the so-called "state of nature", etc.). Situational environment influences the agent's set of values, attitudes and ideas related as follows: values affect attitudes, and these, in turn, lead to a predisposition to perceptions of one level or another, the hierarchical agent's "in memory" is consistent with predispositions system of ideas about the world. A predisposition to certain ideas and a situational context (for example, the actions of other agents) lead to the formation of new or modified old ideas. In accordance with these ideas and the stated goal, the agent makes a decision and performs an action. The results of actions lead to a change both in the situation itself and in the internal values, attitudes and perceptions.

Models of concerted collective action (Chwe, 2000). Social connections are key here. On the one hand, social connections can provide effective local social control to stimulate participation in collective action (due to pressure from their neighbors, trust in them, social approval, the need to maintain positive relationships and meet expectations, emotional affection, preserve their reputation, identifying yourself with your neighbors, etc.). So, for example, the behavior of the neighbors of the agent will affect his own behavior. On the other hand, social connections provide the agent with information about the intentions and actions of other agents in the network and form his (incomplete) ideas, on the basis of which the agent makes his decisions. Finally, within social networks, agents can make joint efforts to create a local public good and share it. Therefore, the structure of social networks has a strong influence on the decisions of agents to take part in collective action.

In (Chwe, 2000), a social network is considered as communication, through which agents communicate to each other about their willingness to take part in collective action. Each agent is informed about the readiness of only their nearest neighbors and, based on this local knowledge, makes a decision on participation using the decision rule "I will participate if you participate" (coordination mechanism). That is, a coordination game with incomplete information is considered. The communication network promotes coordination, and the main interest is what are the properties of such networks that allow collective action. Minimally sufficient networks that build agents into a hierarchy of social roles / steps are considered: "initial adopters", "followers", etc. to "late followers" (late adopters). Such networks facilitate coordination as follows:

- informing each step of the earlier steps;
- forming general knowledge within each step.

That is, it provides an understanding of the role (locally) of general knowledge in collective action and the relationship between the structure of a social network and general knowledge.

The authors (Leskovec et al., 2008) consider viral marketing - the general name for various methods of advertising distribution, characterized by the spread in the progression of close to geometric, where the main disseminator of information are the recipients themselves. This approach is being implemented by shaping the message content in a way that is able to attract new recipients of information through a bright, creative, unusual idea. Also, the effectiveness of the message is based on the use of the natural trusting relationship between the recipient and the sender.

Within the framework of the tasks of online trading platforms in the social networks of the Internet, optimization and simulation models are suitable for the study of interaction processes. Of these, we single out the infiltration and infection models (a class of epidemiological models), since these models most accurately reflect the specifics of the problems we are considering.

THE PROBLEM OF INFORMATION SECURITY

As a rule, questions of reliability, data confidentiality, availability of information resources are analyzed. Vulnerabilities of known systems of trust (reputation), methods of carrying out attacks on authenticity and confidentiality are revealed. Different methods of protection are disclosed.

The mechanisms of trust between users as a way to protect information in a distributed multi-agent structure, such as the Internet of Things (IoT), are considered in (Abera, 2016; Chen, 2015; Sicari, 2015; Wang, 2016; Yu & Singh, 2003). Security requirements include confidentiality and data authentication, network access control, confidentiality and trust between users and objects, as well as compliance with security policies. It is emphasized that traditional methods of protection cannot be directly applied to IoT technologies due to the different standards and communication protocols used. Conclusions are drawn on the need to build a flexible protection system infrastructure capable of countering security threats in such a dynamic environment (Jabeen, 2018).

The authors (Azad et al., 2018) propose a joint reputation system that preserves confidentiality and ensures the accuracy of sensor readings for multi-agent mobile applications. Describes approaches to confronting a number of possible attacks, ways to identify intruders. The system protection is declared with a large number of intrigues of intruders (even if their number exceeds 65%).

The article (Dellarocas, 2004) discusses the problem of spreading false testimony of agents, presents models of fraud and approaches to the detection of intruders.

About fraud behavior of some unscrupulous and deceptive appraisers in reputation systems, the author warns (Walsh & Sirer, 2006). To counteract the undesirable consequences of such fraudulent behavior, “immunization mechanisms” are proposed, it explains how various parameters of the market, in particular, anonymity and authentication modes, can influence their effectiveness.

Methods of identifying false (unreliable) information occurring when querying in the Credence trust system, which operates in the Gnutella file-sharing network, are described in (Hogg & Adamic, 2004).

The authors (Sicari, 2015) note that the availability of online social networks can lead to the possibility of manipulating the mechanisms of reputation through collusion by groups of users or by creating false identifiers (users).

The problem of leakage of confidential consumers information (for example, the history of purchases, likes and dislikes to goods and services) in the existing centralized systems of trust (reputation) that

collect and process consumer reviews is the subject of work (Sathish et al., 2018). The PrivBox system is proposed, in which the reverse confidential communication between users is organized.

In (Yan, 2017), trust and reputation mechanisms based on subscriber behavior monitoring are analyzed. These mechanisms are researched as a method of ensuring the security of wireless networks. A so-called intelligent beta reputation and a dynamic trust model are proposed for secure routing in such networks.

The ability to integrate trust mechanisms into role-based access control (RBAC) models for secure data storage in the cloud has been reported by the authors (Yan, 2017).

The authors of (Mathew & Cheshire, 2017) describe three key cybersecurity issues that are related to Internet infrastructure technologies: interception of IP addresses, email spam, and DNS spoofing.

CONCLUSIONS

1. Reputation can be one of the main characteristics of a company, and its role continues to grow. This can be explained by the following trends:
   - production processes have become opaque for end users. Many products have moved into the group of trustors - users for whom quality is no longer relevant when making a purchase decision, since it cannot be reliably assessed by the consumer - and its functions can be assumed by the reputation of the manufacturer;
   - the development of payment systems in the conditions of sharing economy led to the emergence of a new business model for sharing benefits - an intermediary online platform providing C2C services (Airbnb, Uber). A key aspect in such a model is the agents' trust in each other.
2. Confidence in social networks, when agents are virtual, and, more likely, they are not at all familiar with each other, can only be provided on the basis of information and communication interaction, which depends on the structural characteristics of a social network. If the social network has a feedback mechanism, then the information coming from the source to the agents will be more qualitative, there is a clear connection between the agents in the network, you can determine the mechanism of trust propagation in the chain of agents. The more influential the source of information is, the more likely it is that its opinion will affect the opinion of agents throughout the network.
3. The problem of trust between social network agents includes questions about the reliability of the information source. An integrated approach to data reliability should integrate data quality assessment and data architecture into a single structure with a series of steps, procedures, checklists and tools and take into account user technologies, processes and problems.
4. The basis of the generalized model of assessing the reputation of agents is the degree of trust of agents to each other. There are two approaches to the formation of a reputation model: linear and non-linear (transitive). In the case of a linear approach, the contribution of the indicator (degree) of the trust of the donor agent (influenced) to the reputation of the recipient agent (influencing) does not depend on the current reputation of the donor agent. The non-linear approach assumes that the contribution of the donor agent to the reputation of the recipient agent depends on its own reputation as the donor agent. The greater the reputation of the donor agent, the greater the influence. Reputation characterizes each agent (user) selected for a specific subject area of a community (team). It makes sense to talk not about absolute, but about the relative reputation of agents.

5. Known approaches to assessing reputation and trust are based on the opinions of agents on a specific (centrally asked) question. This approach, as a rule, does not allow obtaining objective assessments and contributes to the manipulation of the survey results in the interests of the creators of the rating reputation system. The solution here could be the creation of an "independent" system in which agents do not directly know that they are participating in the reputational procedure, although there are certain difficulties in forming such a group of appraisers.
6. When developing methods for assessing indicators of reputation and trust in social networks, network topology (the structure of information relations between agents) and the modeling of information distribution processes play a significant role. Within the framework of the tasks of online trading platforms in social networks of the Internet, optimization and simulation models are suitable for the study of interaction processes. Of these, we single out the infiltration and infection models (a class of epidemiological models), since these models most accurately reflect the specifics of the problems we are considering.
7. In the tasks of information security of social networks of the Internet there are two directions. The first approach discusses issues of reliability, data confidentiality, and availability of information resources. Vulnerabilities of known systems of trust (reputation), methods of carrying out attacks on authenticity and confidentiality are revealed. Ways to protect. The second approach offers trust mechanisms between users as a way to protect information in a distributed multi-agent structure, e.g. the Internet of Things.

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Chapter 4
Users of Sharing Economy Platforms in Russia:
Recent Changes in Consumer Behavior

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ABSTRACT

The sharing economy phenomenon has become one of the main trends that influence customer behavior in many markets. The emergence of online service platforms allows individuals and businesses to share their unused or underutilized resources efficiently and expand the locus of value creation through platform ecosystems. The analysis shows that Russian users of the sharing economy platforms for the short-term rental housing find it necessary to have relevant price offers, diversity of hosting proposals, reasonable fees, the web-site quality including booking convenience, availability of feedback and reviews, quick application processing, and contact with the owners of rental property. Aside from the economic, social, and ecological factors mentioned above, the individual factors are proposed to be added to the analysis which will have a substantial impact on specifying target groups of Russian users of the sharing economy platforms.

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INTRODUCTION

In the era of Industry 4.0 Collaboration and ubiquitous digitalization, a number of important trends in economic development arise. The mobile Internet and the Internet of things, VR/AR technologies, artificial intelligence, big data, and machine learning, as well as the spread of automation in economics, lead to impressive changes both in business processes and in consumer behavior. The growing business environment complexity and the acceleration of technological changes lead to the emergence of new forms of social interaction. In particular, sharing economy phenomenon has become one of the main trends that influence customer behavior in many markets. The emergence of online service platforms allows individuals and businesses to share their unused or underutilized resources efficiently and expand the locus of value creation through platform ecosystems (Belk 2007, Grassmuck, 2012, de Reuver et al. 2018). Therefore, the sharing economy leads to an increase in the efficiency of economic and business activities (DuPuis, Rainwater, 2015). There is no doubt that "there is potential in this sector for creating new businesses that allocate value more fairly, that are more democratically organized, that reduce ecofootprints, and that can bring people together in new ways" (Schor, 2014, p.11).

The sharing economy continues to grow in developed countries; it is also affecting emerging markets (Gansky, 2010). As an example, Russians have entered the Top 5 active Airbnb users in 2016 (Forbes, 2017). From May 2016 to April 2017, the number of rental housing in Russia using Airbnb increased by 85% compared with the previous year (RBC, 2017; Melkadze, 2021).In the meanwhile, the current development of the sharing economy in Russia is boosted due to the growth of internal Internet-users. However, in a volatile economic environment, further development and growth of the buyer's market considerably depends on the set of barriers and drivers faced by customers.Additionally, the current situation with the COVID-19 pandemic has become a reason for a serious concern about the near future of sharing economy (Dolnicar, Zare, 2020; Hossain, 2021) due to hygiene issues. At the same time, the necessity for social distancing became a positive driver of car-sharing services use instead of public transportation or taxi (Huang et al., 2021).

BACKGROUND

In the literature, there is growing discussion concerning drivers and impediments of using sharing economy platforms. Calcagni et al. (2016) propose to take into account social, economic, and ecological drivers of and barriers to real sharing practices.

Among the most effective drivers that cause the growth of the sharing economy, it is worth mentioning the following ones (Selzter et al., 2010; Heinrichs, 2013, Kavoura, Katsoni, 2013, Matofska, 2015, Böcker, Meelen, 2017; Gruszka, 2017; Selloni, 2017; Hossain, 2020):

The development of information and communication technologies. Web- and mobile devices including tablets and smartphones complete with Global Positioning System (GPS) and Near Field Communication (NFC), can provide high-speed contact and interaction. They are gradually turning into the main means which helps people manage their life on the Internet and play a particular role in creating bigger communities for sharing. Due to convenient interface, following fashion trends, new experience, feedback, and discussion opportunities users themselves act as drivers, inviting their surroundings to use services or providing these same services for use, thereby achieving self-satisfaction.

The development of ecological literacy. The sharing economy and steady development are interrelated concepts (Kotler, Armstrong, 2010), since many people who choose to share, justify their choice as their willingness to be more environmentally friendly. With low-resource settings being the characteristic of the current stage of global development, the sharing of resources and available assets will mark a shift towards a more sustainable lifestyle.

The global recession. It is widely believed that financial savings have become a key benefit of sharing. This trend is particularly important during the economic crisis. The research sponsored by Airbnb found that more than half of adult respondents agree that the ability to borrow or rent one's property or assets on the Internet is a great way to save money. At the same time, the desire to save money does not contradict the concept to do any good to society and the environment. These two principles are often equally important for those people who make their decision to join the sharing practice.

The COVID-19 pandemic. It is important to investigate possible long-term effects of the COVID-19 pandemic on the trading of short-term rentalspaces using online platforms.The COVID-19 pandemic induced economic shock in three different ways: the economic shock and the consequent travel decline; this economic shock is more dramatic, with reductions to economic growth twice as big as those caused by regular shocks (Dolnicar, Zare, 2020).

Internationalization and sense of community. Internationalization results in cultural transformation and makes most people switch to the principles of sharing economy. Over the past two decades, customers (in particular, Gen Xers and Millennials generation) have got to feel comfortable and safe purchasing goods and services online including shipping from those foreign countries they have never visited and from those people they have never met before. In this sense, trust has become a kind of "new currency" for sharing economy transactions. (Godelnik, 2017). Nowadays, customers follow the principle of "getting more at the lowest possible cost". The principle has given birth to a new "breed of owners" who also tend to rent, provide for temporary use, and share their benefits, either for personal economic gain or for the drive of public goods promotion. At the same time, the civil or racial rights movements can also be classified as the social drivers of the sharing economy since their participants identify themselves with the same social group and share common challenges and concerns. In this case, willingness to cooperate is focused on the improvement of the social status.

The lack of an adequate regulatory framework for the sharing economy business models is the main economic barrier, leading to controversial issues about taxation, insurance, licensing of such organizations, consumer protection, labor exploitation (Kavoura, Katsoni, 2013, Schor, 2014, Klarin, Suseno, 2021). The lack of trust between people, as well as the lack of stability in user behavior caused by differences in cultural values, social norms, and human habits, are the major social barriers (Kavoura, Katsoni, 2013, Matofska, 2015, Kraus et al., 2020). One more barrier is big data available to the web-based platforms and used to calculate and change the price level for the services in response to demand. These factors might result in high-income disparity or racism when the choice between from whom to purchase or to whom to provide the service depends on the level of education or the skin color. Moreover, such factors as mistrust of strangers or the service itself, disgust, risk of not receiving the service at the right moment, the necessity to put in the effort to participate, as well as the inability to stay anonymous, are generally also considered as the barriers affecting the consumer decision to join the sharing economy (Venkatesh et al., 2003, Hawlitschek et al., 2016).

The ongoing empirical research is planned to be carried out in the mixed mode. The quantitative study, scheduled for the second half of 2019, is preceded by the work with public information and the

qualitative stage that is focused on identifying the special features of perceiving Airbnb platform by Russian users, as well as the factors affecting their decision to join the sharing economy platforms.

The analysis of search queries from Russian tourists (Advise Group, 2018) shows that they use both the online hotel reservation services (first and foremost, Booking.com) and the booking module on Airbnb.ru. Accordingly, the market of short-term rental housing works as a system.

The analysis of feedback from Russian users of the sharing economy platforms seems to have been as follows: initial identification of options mentioned in the feedback followed by adding the emotional coloring to the options by the reviewers. Accordingly, one and the same review might have included several quality criteria of the service performance.

The analysis of feedback about the operation of online platforms popular with Russian tourists shows that the number of negative reviews for Airbnb.ru is higher than for its competitors operating under different business models(Rebiazina et al., 2020). The weakest points reside in high fees, low quality of the support service, payment convenience, and inflexible cancellation policy.

In general, the analysis shows that Russian users of the sharing economy platforms for the short-term rental housing find it necessary to have relevant price offers, diversity of hosting proposals, reasonable fees, website quality including booking convenience, availability of feedback and reviews, quick application processing and contacts with the owners of rental property. In terms of rental housing itself, potential tenants pay greater importance to reliability, service, discounts, and a "good host" status.

However, it seems to be considered that the growth of users of the sharing economy platforms makes it necessary to divide this large group into such consumer clusters as those who tend to economize, try something new, seek home-like living conditions, etc. Representatives of those clusters differ in their preferences, motivation, and interests.

Accordingly, follow-up studies will benefit from the method of factor and clustering analysis. Aside from the economic, social, and ecological factors mentioned above, the individual factors are proposed to be added to the analysis which will have a substantial impact on specifying target groups of Russian users of the sharing economy platforms.

The results will be of interest to the management researchers and practitioners with a view to foster a greater understanding of expectations and certain aspects of Russian consumer behavior.

Currently, there is no generally accepted definition of the sharing economy concept since the industry is still being intensively developing. However, more and more companies are adopting their structure to this new business model as a part of the sharing economy. The business model of the sharing economy is characterized by the following features:

- focus on unused or underused assets;
- temporary access prepaid by customers instead of transferring the ownership right to provide a web-based platform;
- networking effects and social interactions between users and suppliers as the main principle of business (Parente et al, 2017).

The last component is highly important since a new business model functions as an interface connecting different groups of users who interact through a virtual market following a set of established "rules" and regulations (Gawer, Cusumano, 2014). One of the key advantages of the Internet-platform is a considerable reduction of transaction costs relating to customers' demands met by potential suppli-

ers (Eisenmannetal., 2008; Gawer, 2009). In this case, firms, specialized in providing online platforms, focus on the following issues:

1. Client data collection with a view to reducing the cost. The data collections carried out by increasing the possibilities to monitor transactions (e.g., GPS tracking) and assess other inherent risks (e.g., customers/suppliers reviews and ratings).
2. Short-term contracts with a low level of commitment. Such contracts are primarily possible due to technological improvements which allow customer-provider networking and interaction at virtual trade platforms.

The sharing economy can be considered as a sort of "platform capitalism" based on intermediate firms dealing with data analysis and market monitoring that makes their corresponding fees from rental transactions (Langleyet. al., 2017). Customers are involved in the exchange not only to try a new type of social interaction but also to escape ownership liability and reduce costs. However, institutional issues are not the only facts having affected the increasing popularity of this economic model (von Briel, Dolnicar, 2020). Changes in consumer behavior are an equally crucial factor. Whereas a yesteryear model of goods ownership used to be a dominant form of property (e.g., for vehicles), nowadays the younger generation is more attracted by the temporary use of goods and services (Matzler, Kathan 2015; Rifkin 2014). Typical examples includecar2go – the company-owned by Daimler, Nextbike and GreenBikes Barcelona – the companies providing bike rental services. Typical examples include car2go – the company owned by Daimler, Nextbike and Green Bikes Barcelona – the companies providing bike rental services. The key reasons for this shift of interests include comfort, low price, eco-friendliness, Internet and mobile apps development, etc.

From an environmental perspective, the sharing economy makes it possible to reduce waste due to the reduction of goods and services production. It is widely viewed that the sharing economy platforms enhance the conservation of natural resources that, in turn, have a positive impact on the ecology. However, some scholars consider this phenomenon as one that might have some negative ecological impact (Schor, 2016). It can provoke the situation known as the Jevons paradox, namely that the increase in consumption goes aside with reduced costs. For instance, a person, being on holiday, rents a flat with Airbnb that makes him consume too many limited resources, such as electricity and water. However, environmental awareness is likewise becoming an essential factor to boost the benefit sharing and enhance it as the means to promote a different consumption paradigm. From this perspective, people should be encouraged to share consumption, mutually influence each other, as well as follow established ecological principles such as recycling and efficient use of resources (Bos, Cuddy, Doherty, 2012).

It could be argued that sharing consumption is a hybrid model of the sharing economy, which inherits the nature of the traditional form of the market relationships where two counterparts exchange the right to own goods or services for money or as a gift with no compensation for transaction costs (Möhlmann, 2015).

As a result of systematization and reviewing of the key approaches, the authors of the manual suggest a complex definition of the sharing economy as a new business model implying the process of delivering values by the counterparts of the interaction sharing consumption, borrowing, recycling, and donating goods and services.

DEVELOPMENTAL CHALLENGES OF SHARING CONSUMPTION IN RUSSIA

Issues, Controversies, Problems

The trends in the sharing consumption development in Russia and features of customer behavior at the Russian market of collaborative economy are of particular interest. But to date, this issue is reviewed and considered by a limited number of relevant studies (GFK Rus, 2017; Nielsen, 2017; Melkadze, 2021). The sharing economy market in Russia has experienced accelerated growth over the observed years. Marking 50 and 39 percent growth rates in 2019 and 2020, respectively, relative to previous periods (Melkadze, 2021).

The impact of the major existing works is characterized by such significant drawbacks as focusing solely on e-commerce, fragmentation, mainly theoretical reviewing, lack of sample or diagnostic tool descriptions, empirical data limitations. They fail to show barriers and gaps between the use of drivers by representatives of different generations.

It is noteworthy that in 2016 Russia has been classified among the top ten countries with the fast development of the digital economy (Nielsen, 2017). However, only a small number of findings outline the main features of customer behavior in the Russian sharing economy. Consider the most relevant ones.

According to the 2017 survey of the Regional Center of Internet Technologies, a quarter of the Russian citizens are actively using the services of the collaborative economy. Notable among them are the following: Uber, Airbnb, Blablacar, YouDo, Delimobil. Most respondents contribute to their mistrust of the services and consider it the principal obstacle to their participation. The GFK research (Young et. Al., 2010) reveals the same trend: strong and respectable brands are being socialized at the market of the sharing economy creating channels for dialogue with consumers and increasing the degree of their trust. It is clearly confirmed by the communication strategies of Uber, Airbnb, Blablacar, YouDo, Delimobil.

In general, according to the report by the GFK group "Global trends vs Russian customer" (GFK, 2017), factors affecting the customer behavior in European countries are also relevant for Russia. The key trends include globalization (unification of customer behavior), urbanization and migration (adaptation to the new environment and introduction of national variations), population ageing (growing number of conservative and less flexible elderly consumers with higher requirements in quality and comfort), the preeminence of the nuclear family (relatively high standards of living and personal use sufficiency), equality of the gender roles in taking the decision to purchase, the rapid development of digital technologies.

SOLUTIONS AND RECOMMENDATIONS

The quantitative data reflecting consumer perspective was collected from a survey of Internet users that participated in the online course "Marketing" held on The Russian National Educational Platform "Open Education" (The Russian National Platform...). The study involves respondents from this business course. The online version of the questionnaire was developed on a platform "Survey monkey", a survey development cloud-based software (SurveyMonkey). About 10 000 Internet users took part in the course, and the survey link was sent to all participants of the course. With a view to identifying the most popular services for sharing consumption, in autumn 2017, an online survey was conducted. The response rate was about 20 percent including 2,047 respondents.

The questionnaire was structured to address 30 questions using the nominal and ordinal scales. The checklist included the following group of questions: drivers, barriers, individual focus on innovation, sociodemographic characteristics of respondents. Agreement or opposition to the statements was measured with the Likert scale that ranges from 0 "not at all likely" to 7 "extremely likely".

The greater part of the responders was made by young people between the ages of 18 to 35, with university degrees and medium-income level, mostly women (72%). Since most respondents live in the biggest Russian cities with a population of over one million, and different services of the sharing economy being widely available, it can be assumed that they have enough awareness and experience in using these services. A summary of the survey is provided in Table 1.

With young respondents (under 35 years old) and residents of the biggest Russian cities, there is a tendency to use the services of sharing consumption several times a month, whereas the older generation (aged 35-60) and residents of smaller cities tend to use the services every few months. Upper-middle income respondents are not likely to use the services more often – a few times a week (Table 2).

One in two respondents has already contracted for rental of services, however, services such as rental of goods (46% of respondents), short-term apartment rental (44% of respondents), and online purchasing (42% of respondents) are a bit less popular (Table 3).

Taxi request and online purchase are of primary concern for further development, four out of ten respondents have already used the Uber, GetTaxi and Avito services, about as many are going to try the services in the future (Table 4).

FUTURE RESEARCH DIRECTIONS

Over the past decades, the development of the digital economy has rapidly increased and made it possible to create new products and ideas ready to be carried out as online services for sharing consumption. The digital revolution helps to meet various and constantly increasing consumer demands due to the efficiency of processes and products. Six out of ten respondents of the online survey accept the innovative feature of sharing consumption as a response to the modern lifestyle. Three-fourths of respondents consider sharing consumption as the trend to keep up with the times.

However, despite their willingness to use the sharing customer services in the future (60% of respondents are willing to share goods in the future) and a relatively high level of trust in the services (60% of respondents), only 30 percent of users feel ready to rent their property. According to the respondents' replies, insufficient willingness to share relates to high risks of failure, hygiene, and personal safety issues. It should be noted that one-third of respondents consider it vitally important to own common goods since it identifies their social status. Therefore, this barrier prevents this group of Russian consumers from using the sharing consumption services.

Similar results were reported in the 2016 spring survey carried out by the National Agency of Financial Studies: despite the general willingness and active involvement in different sharing consumption services, only 17 percent of Russians feel ready to rent their property (GFK Rus, 2017). The potential of savings and opportunities of additional earnings provided by the sharing economy are overshadowed by the security issues and mistrust of the services and their participants.

Table 1. Sample characteristics (N=2047)

Feature	Feature type	N	%
Gender	Male	743	27
	Female	1995	73
Age	Under 18	12	0
	18-25	1052	35
	26-30	736	27
	31-35	505	18
	36-40	246	9
	41-50	230	8
	51-60	48	2
	Over 60	9	0
Education	Lower secondary	16	1
	Secondary	64	2
	Secondary vocational	82	3
	Incomplete higher	515	17
	Higher	1735	62
	Two or more higher education	339	12
	PhD degree	87	3
Income	Not able to afford food	76	3
	Able to afford food	31	1
	Able to afford food and clothes but forced to save for larger purchases	361	13
	Able to consume durable goods (fridge, TV) but not able to purchase a vehicle	1285	43
	Able to purchase a vehicle but not able to buy an apartment	728	27
	Abletodenynothing	357	13
Marital status	Married/Civil marriage	1421	48
	Divorced	163	6
	Single	1254	46
Size of locality	Over 1 mln	1960	68
	500 thousand – 1 mln	318	12
	100-500 thousand	327	12
	50-100 thousand	83	3
	Under 50 thousand	79	3
	Don’t know	71	3

Source: Own research

Table 2. Frequency sample characteristics on the use of sharing consumption services

Feature		Frequency of use of sharing consumption services (N)						
		Every day	1-2 times a week	A few times a month	Once a month	Every few months	Once a year or less	Never used
Age	Under 18	2	1	0	1	5	1	2
	18-25	35	121	258	128	295	116	32
	26-30	37	67	221	113	225	89	27
	31-35	13	44	121	67	167	82	16
	36-40	9	15	54	28	85	51	11
	41-50	7	8	35	22	81	65	24
	51-60	1	1	11	10	12	8	7
	Over 60	1	0	0	0	3	0	3
Income	Not able to afford food	2	1	4	12	9	8	1
	Able to afford food	6	3	15	22	24	23	6
	Able to afford food and clothes but forced to save for larger purchases	36	27	342	163	462	192	62
	Able to consume durable goods (fridge, TV) but not able to purchase a vehicle	34	85	215	117	256	104	31
	Able to purchase a vehicle but not able to buy an apartment	21	56	161	53	124	57	12
	Abletodenynothing	6	8	22	6	29	13	8
Size of locality	Over 1 mln	70	198	523	249	577	231	68
	500 thousand – 1 mln	12	37	81	36	98	49	10
	100-500 thousand	15	15	65	61	96	79	22
	50-100 thousand	4	9	11	9	39	22	6
	Under 50 thousand	2	2	13	10	23	24	10
	Don’t know	1	6	11	6	21	12	5

Source: Own research

CONCLUSION

In sum, it might be concluded that the phenomenon of sharing consumption is becoming an integral part of Russian consumers’ everyday life. The survey of the Regional Center of Internet Technologies (2017) showed that every fourth Russian citizen regularly used the sharing economy services, including Uber, Airbnb, Blablacar, YouDo, Delimobil as the most popular online services and naming mistrust to the services as the major barrier to greater involvement. The growing interest of Russian users towards the services of sharing economy is confirmed by the request statistics of the most popular search engine Yandex. According to Wordstat Yandex data, among the most popular services are food delivery, short-term car rental, and online teaching, whereas the services for goods rental are the least accepted. A

significant increase in the number of requests has also been demonstrating consumers' growing interest over the past years, for instance, by 66 percent for the services of food delivery and by six times for the sharing consumption (Table 5).

Table 3. Consumer awareness of the sharing consumption services

Service	Respondents have already used the service		Respondents are familiar with the service and are going to try it		Respondents are familiar with the service but are not going to try it		Respondents are not familiar with the service	
	N	%	N	%	N	%	N	%
Carsharing	1038	37	897	32	681	24	222	8
Rental of goods	1079	38	452	16	826	29	481	17
Rental of services	1239	44	745	26	693	24	161	6
Taxi request	1381	49	1298	46	148	5	11	0
Purchaseon e-platforms	1345	47	1129	40	332	12	32	1
Intercity traffic	1047	37	635	22	744	26	412	15
Short-term apartment rental	1381	49	1094	39	321	11	42	1

Source:Own research

Table 4. Consumer awareness of the sharing consumption brands

Service	Respondents have already used the service		Respondents are familiar with the service and are going to try it		Respondents are familiar with the service but are not going to try it		Respondents are not familiar with the service	
	N	%	N	%	N	%	N	%
Delimobil	415	15	267	9	302	11	1854	65
BelkaCar	197	7	173	6	236	8	2232	79
YouDrive	272	10	169	6	271	10	2126	75
Anytime	151	5	41	1	56	2	1790	63
Rentmania	98	3	66	2	128	5	2546	90
Uber	1368	48	951	34	285	10	234	8
GetTaxi	1193	42	748	26	324	11	573	20
Dog-Walk	185	7	51	2	204	7	2398	84
Avito	1387	49	1176	41	156	5	119	4
BlaBlaCar	1137	40	644	23	564	20	493	17
AirBnB	744	26	654	23	245	9	1195	42

Source: Own research

Table 5. Search query statistics of the sharing consumption services in Russia

Search category	Search period		
	31.03.2016	31.03.2017	31.03.2018
Food delivery	255531	425013	425013
Carsharing	32631	199712	199712
Online teaching	69057	74999	74999
Coworking	49701	64045	64045
Crowd funding	28919	32237	32237
Private loans	27394	24176	24176
Online medical consultation	6968	9796	9796
Goods rental	3884	5174	5174

Source: Wordstat Yandex (Wordstat, 2020).

The research findings make it possible to determine the services that are the most popular with the Russian users engaged in the sharing consumption and which they plan to use in the future. They are service rental, goods rental, short-term apartment rental, online purchase. The review of the existing studies reveals the key factors, including barriers and drivers that can impact consumer behavior in sharing consumption. The empiric research of the Russian consumers shows that the businesses in the sharing consumption industry should pay more attention to the issues of consumer confidence in the common model of collaborative consumption and in several services. This factor is assumed as one of the biggest barriers in the industry market in Russia.

The review of the existing studies proves that sharing consumption makes a highly controversial phenomenon as a part of the cultural shift caused by a number of factors, foremost of which are the information-communication technologies.

New technologies provide rapid development of the sharing consumption as a hybrid model of the sharing economy where two counterparts typically exchange goods or services for money or any other compensation through the Internet (Klarin, Suseno, 2021; Verma, Gustafsson, 2020). The assumptions of the growth and development of this consumption model in its current form include institutional and informational gaps, a high level of bureaucracy, low added value in a traditional business model, general changes in consumer behavior (Dolnicar, Zare, 2020).

Research interest in the sharing economy specificity is demonstrated by the increasing number of scientific publications. However, the existing studies primarily focus on the developed economies and fail to cover the sharing consumption fully. Poor research attempts to systematize the conceptual framework of the sharing consumption phenomenon are seen as the lack of the term consistency and the controversy of its constituents.

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Chapter 5
Technological Revolution in Financial Intermediation

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ABSTRACT

The chapter presents current issues in innovative modernization of financial intermediation. Development of financial innovation in recent years has led to significant structural and functional changes in the system of financial intermediation. New technologies open broad prospects allowing the radical reduction of the costs of information transmission and processing, while exacerbating competition and stimulate the emergence of new financial intermediaries. This chapter analyzes the debate on the theoretical understanding and analysis of financial intermediation, the disruptive technologies influence the economy with focus on organizational changes in financial markets, the use of digital currencies, exploration of blockchain technologies applications, etc. The chapter discusses how technologies have changed the market and the perception of customers as they foster entrepreneurial creativity and disrupt existing financial markets through an introduction of innovative business models of modern credit institutions.

INTRODUCTION

The world has entered a new phase of development known as the “digital revolution” - mass introduction of big data and computer technologies. The observed changes in the world are defined as “digital society”, “digital civilization” and “digital economy”. The latter is a response to the 4-th industrial and technological revolution global challenges. Digital economy was presented at the World Economic Forum in Davos and the G-20 Summit in Hangzhou as a driver of economic growth.

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Global trends in the development of financial markets (structural changes in the world economy, the high volatility of national currencies in emerging markets; financial globalization; increased competition in financial markets; the development of information technology, financial innovation and financial engineering; accumulation of risks and tightening regulation after the crisis) influence greatly the domestic economy. Actively developing trend on digitalization the economy will certainly have a positive impact on transparency of business environment.

Dynamic changes under the influence of technological revolution in financial intermediation are seen in the banking sphere: 1) automation of management and accounting; 2) electronic money transfer records on magnetic and optical media; 3) all payments transactions are carried out on the basis of information and computer technologies (ICT).

Promising ICT utilization in banks is to develop remote customer service channels (including automated electronic offices with customers using robots, biometric data, identification of customers by voice, the retina of the eye, the shape of the lips and other individual characteristics). Private customers of banks use plastic cards, mobile phones, computers or Internet banking in order to accelerate, reduce the cost of providing services and improving the safety performance of operations for banks and their customers.

The digital revolution rapidly burst into such a conservative area, as the world of money. Truly revolutionary development was the emergence of the new alternative forms of money, called "electronic", "cyber", "digital" and "virtual". The emergence of private digital currency is associated with the development of the Internet industry, cost optimization, e-commerce companies (Aliexpress, Ebay, etc.) and the emergence of the major international payment systems (ApplePay, SamsungPay, LGPay, AliPay, etc.). However, some experts consider the private digital currencies (bitcoin, litcoin, etc.), on the one hand, as a tool of the Internet industry, and as an instrument which allow to optimize tax deductions, develop the shadow economy, drug-traffic, and loss of influence in the market of traditional currencies (US dollar, Euro, Pound sterling, Japanese Yen etc.) on the other hand.

However, it is important to emphasize that digital currency is only one element of modern payment and settlement systems. The emergence of new digital currencies involves the development of norms and rules regulating their use; information infrastructure; definition of information security issues, regulation of cyber-risks; training and education in the field of information technology and improving the financial literacy of the people; formation of research competences etc. It requires thinking in terms of opportunities and risks for human beings and society in general, as well as practical use of mechanisms and establishment of digital platforms.

The emergence of digital currencies involves the development of a regulation; creating an information infrastructure; information security, regulation digital risks; retraining and improving the financial literacy of the population, etc. In this context, a number of central banks have started developing their own (national) digital currencies (Bank of China, for example). The Parliament of Japan adopted a law in 2017, under which digital currencies received the status of legitimate money. Now bitcoins are used for payments in cashless form through the system of electronic payments and settlements. Regulators believe that the use of digital currencies will improve security, reduce the cost of cash emission, improve transparency of calculations, etc. But is it really? How does the digital economy affect the scope of traditional money?

Criminals managed to steal amounts in cash equivalent to 49 million dollars from the British Central Bank (2006), Brazil's Central Bank - 69 million dollars (2005) and Bank of France - 17.2 million dollars (2009). Since then there is no evidence of large robberies of central banks and private commercial banks in the form of cash. However, information and computer innovations have resulted in the world

became rapidly entering an era of electronic theft. The objects of theft have become non-cash money and customer information (personal data, information about transactions, credit, etc.). In the era of the "digital civilization" information becomes a commodity that has its price and consumers. In 2016 hackers attacked the SWIFT and steeled 81 million dollars from the Central Bank of Bangladesh. Recently, a number of countries have enacted laws on the personal data protection. However, the number of victims is now millions of people worldwide. Goals of hacker attacks on banks are no longer limited to the theft of money and information. Now it may be destroying or weakening the Bank competitive position (e.g., Bank systems after infection by viruses, etc.).

Modern man (especially representative of the younger generation) already can't imagine himself without a smartphone, electronic devise and a bank card. But data security on these devices, regulatory framework for the protection of personal data and security of savings raises many questions. Prospects of the digital economy are unthinkable without a productive cooperation of business and state; the conditions of such interaction are transparency, credibility and innovation relationship.

BACKGROUND

The study uses comparative methods, benchmarking to market practices and international consultancy recommendations. Among them are the results of research projects conducted by Allen F., Santomero A.M., Merton R.C. and other theoretical and empirical researches. Robert C. Merton (1995), for example, has made his contribution to the theoretical understanding and analysis of financial intermediation. Speaking about the so called "functional perspective" he pointed out that any financial system should ensure the implementation of a complex of basic functions and structure of the financial sector regulation of its institutions, which being much less stable and may transform within country jurisdictions to provide effect.

The new approach sparked debate in economic literature and allowed to find an explanation of the organizational changes in financial markets. Confirmation of these changes has been the rapid development of the so-called "shadow" (unregulated) banking system. The participants of that system perform intermediary and credit functions for households and companies faster and at less expense than traditional banks. However, innovation support growth of efficiency of functioning of financial and credit institutions, while at the same time led to a significant increase in systemic risks that have materialized during the global financial crisis (2008-2009).

The basis for the analysis were the reports and other materials of the World Bank, Bank for International Settlements, PwC, Deloitte Center for Financial Services, Bloomberg, Citibank, La Caixa Bank (Spain), Banking Association for Central and Eastern Europe (BACEE, Hungary), Association of Russian banks (ARB), Sberbank and Tinkoff Bank (Russia), etc.

The main objectives of the chapter are to reveal a modern problem of traditional banks change in finance industry and to show the way for its further development.

FINTECH-COMPANIES AND TRADITIONAL BANKS: CONSTRUCTIVE ENGAGEMENT AND/OR DESTRUCTIVE COMPETITION

Informatization in Banking

The key to increased productivity in banks is automatization of banks' services. New advertising technology is founded on the principle of "to every client – an individual approach and separate product" ("one to one"). It allows the bank employee to instantly receive data on the socio-demographic, professional, property status of the client, as well as on the structure of its income and expenditure. All this information allows the banker to take the necessary and most effective solutions in the shortest possible time.

Resistance databases for storing personal information of customers are also an important parameter when considering this issue. Data security is a critical indicator of the banking business efficiency. Privacy access implies the differentiation of levels of access to databases for employees of the Bank. Created innovative services increase the quality of the bank customer service; ensures high reliability of the payment system and simultaneously release employees to work on more promising areas.

Modern basic principles of the banking sector development through the introduction of new technologies include:

1) Modular design;
2) Openness to new technologies and systems;
3) Flexible banking modules and their adaptability to the needs of a specific bank.
4) Scalability; expansion and increasing complexity of functional systems with the development of the structure of commercial bank.
5) Wide access to online databases with preservation of differentiable access levels.
6) Modeling of business processes of the Bank.
7) Development and improvement of the system through the reengineering of business processes.

For example, "Sberbank" employees provide their customers automated banking services, introduce new remote service channels. Sberbank, for example, implemented: Sberbank-Online (more than 30 million users); mobile application Sberbank-Online for smart phones (more than 18 million users); SMS-service "mobile banking" (more than 30 million users); the largest network of ATMs and self-service terminals (more than 90 thousand devices). These processes lead to a reduction in staff, by 2025, in two times.

Tinkoff Bank (the Russian online bank that has no ATMs and offices) uses voice identification of customers for fraud protection and accelerates the work of a call center, as well as large data processing technology, including data from social networks to predict credit risk.

Financial technology is a prime example of how the technological revolution has affected quite a conservative financial sector, which is still representing traditional services (deposits, lending, etc.). But the large retail banks are no longer the sole players in the financial market. FINTECH is betting on high availability, speed and comfort, and gaining the trust of customers.

Modern Problems of Banks - Background Change in the Industry

The problem of millennials. Sociologists created the so-called "Millenial Disruption Index" to assess potential changes in the world economy with growing involvement of the young people (millennials).

According to it, the cardinal restructuring most at risk are banks. Notes record low fidelity to its bank: 53% of respondents believe that their bank does not offer anything special compared to other, 1/3 ready to change bank in the next 90 days, 33% see no point in banks. But most importantly-73% more likely to wish to use new financial services from major technology companies like Google and Facebook, than have to deal with traditional banks. The needs of the new generation are an affront to the entire banking system.

The problem of the underbanked. According to the World Bank for 2.5 billion adults — about half of the working population – formally are isolated from the world financial system. In many regions of the world, almost no banks and in other populations for a variety of reasons, do not trust their savings to banks. Nearly 60% of the adult population of Mexico has never opened a deposit in the official financial institution with that 97% of the population lives in an area with a minimum of one point of access to the formal financial system. The proposed statistics of the Bank for International Settlements *(*2015) means serious weaknesses in the banking system of Mexico, among other things, one of the most stable in the world.

The problem of the consequences of the crisis. After the crisis of 2008-2010 confidence in banks fell sharply. Crisis entailed serious new restrictions for banks, increased lending rates because of new capital and liquidity adequacy standards imposed by the Basel Committee on banking regulation, grew commissions for payments and transfers, because banks have been looking for new ways to earn new financial ecosystem. In addition, lending to small and medium-sized businesses significantly reduced.

Fintech is an Attempt to Solve Problems

In the view of falling reputation of banks new opportunities for the development of fintech-companies and fintech-industry appeared.

In the past buying shares and investments were the lot of the rich. Today the situation has changed. Creation of crowd-funding platforms (Kickstarter, Crowdcube, etc.) provide everyone with opportunity to invest in different projects without any charges and minimum expenses.

Serious competitor for banks' services is P2P lending system, which is regarded as an equitable system of lending. The market of loans granted through the P2P system is constantly growing and now provides clients the opportunity to open a deposit under the more advantageous interest than in a bank. The demand has spawned a proposal and created a new technology industry-FINTECH in conservative financial industry, serving three main directions: payments and transfers, equitable lending and investing.

Payments and transfers. About 23% of investments in FINTECH in recent years have focused on the development of the system of payments and transfers. The fact is that people around the globe submit each other annually $3 trillion, so many entrepreneurs see in this area a lot of room for development. One of the most successful projects in this field recognizes the service of international transfers system Transferwise. It competes with the largest banks and such giants as Western Union.

The world's first mobile payment system M-Pesa, launched in 2007 by the Vodafone subsidiary and the largest cellular operator Safaricom. Now it provides access to basic financial services to the country's population of Kenya. User friendliness (the service was integrated into the SIM card) led to what is now about 85% of the adult population of the country enjoys mobile wallets to pay for cellular operators and small remittances.

Investing. Recently, buying shares and investing in general were only for the rich. Today the situation has changed dramatically. Many crowd-funding sites (Kickstarter, Indiegogo, Crowdcube, etc.), where

anyone can visit the site, download the app and invest in one of the projects (from rock band to a Service Center for the drones; or in projects for millennials, such as application Robinhood, which allows you to trade stocks of American companies and perform simple operations on the Exchange without any charges and minimum contributions).

Lending. The proportion of investments in financial technology as loans accounted for more than 46%. P2P lending system is among the other serious competitors of banks' services. Equitable lending first emerged in the UK in 2005, when the system Zopa was founded (Available at: https://www.zopa.com). Today, the total volume of loans via P2P system amounts to 2.6 billion. This figure until the incompatible with traffic in large banks, but the market is growing. Moreover, in addition to P2P loans provides the ability to open a deposit under the more advantageous interest than the Bank offers. People can also open a deposit in the small electronic banks.

Competition or cooperation?

Traditional banks are worried that their business may be at risk due to the development of the segment of financial technologies. Fintech companies expect to receive 33% of the traditional banking business. Citibank forecasts growth in the influence of financial technologies can lead to the loss of work for 30% of banks to 2025 (Available at: https://www.citivelocity.com/citigps/ReportSeries.action?recordId=51) and the Director General of the Spanish bank BBVA in early 2015 predicted that half of the world's banks will disappear under the onslaught Digital industry and FINTECH-waves.

Banks need cooperation with fintech-companies. Big banks can open up enormous opportunities for fintech-companies and give them access to global payment systems. Many banks have already realized that cooperation is the key to survival and prosperity in the midst of a technological revolution, and the more sensible solution than the competition. For banks and startups FINTECH profitably join forces to resist the onslaught of technology giants such as Apple, Google and Facebook, which gradually come onto the market of financial services.

In addition, if the banks need to cooperate mainly for survival in a new environment, FINTECH firms get tremendous opportunities. Log on to the financial markets was always a complicated high hurdles, as well as other regulatory standards. Some services that seek to provide Fintech-company can be provided only to those who have a banking license. Moreover, the big banks can offer Fintech companies their broad customer base and access to global payment systems. As a result, cooperation with banks for FINTECH companies is profitable, because it lowers the barriers to entry to the financial markets, and invites them to a higher level of trust.

A good example of cooperation could serve an experience of leading Spanish bank La Caixa by competent customer segmentation. To increase proximity to customers and increase their confidence in financial services, the leading Spanish bank went on an innovative solution - joint with Fintech teams develop products targeted at different consumer groups. Some examples are:

- imaginBank - banking services within the Group of "La Caixa", existing only in the form of a mobile application focused on segment of the 18-35 year-old customers;
- Hola Bank - service for expats to provide them banking services as "at home";
- Family-Bank is oriented on Spanish families and offers various discounts programs, preferential loans and other services.

Due to the innovative approach La Caixa bank (Available at: https://www.caixabank.es/particular/holabank/particulares_en.html) expanded its market share for 6 years from 10.2% to 16.1% and became the largest retail bank in Spain.

Thanks to the innovative approach the Bank expanded its market share in Spain for 6 years from 10.2% to 16.1%, becoming the largest retail bank in the country with 13.8 million customers.

JPMorgan Chase uses the cooperation with FINTECH start-up to credit 4 million small and medium business customers (Bloomberg (2015). It went to the partnership with OnDeck, - one of the largest online platforms for lending to SMEs. This decision allowed a small self-funded startup significantly reduce spending to attract borrowers and capital (loans are granted at the expense of JPMorgan). And the Bank used such competitive advantages of startups as flexibility and speed of decision-making.

Thus it becomes obvious that the most natural for the banks will be building cooperation with small teams of experts in the field of financial technologies to confront the technological giants, maintaining a client base and reduce costs.

Financial Innovation, Digital Currencies, Risks and Institutional Stability of Banks

The world monetary system now is "drifting" from the system, which unites the national monetary systems, based on national currencies turnover to multi-currency system based on the broad application of advanced information technologies.

Digital currencies are actively submitting world, nevertheless, prohibited in some countries, while in others, on the contrary, very actively used. The most active users of bitcoins are clients from Spain, Sweden, Germany and Argentina. South Korea plans to adopt a law on the legalization of digital currencies. Japan is the only country in the world where the State control on digital currencies transactions was implemented. At present, there is a probability of public digital currencies occurrence.

On the contrary Chinese authorities banned the production of bitcoins. Central Bank of Russia continues to examine the treatment of digital currencies and use of technologies, taking into account the associated risks. CBR, as mega-regulator of financial markets, is highly concerned about the possibility to lose control of money supply, which is fraught with grave economic and political consequences. In future digital currencies will find its rightful place in the global payment system provided effective adoption of new digital technology with keeping control of financial markets at the national and international levels.

Biometrics in Banking

Biometric authentication, or biometric procedure for verifying the identity of the person on its physiological and biological characteristics, includes: face recognition, fingerprint, voice, retina, etc. The main advantage of biometrics is high reliability and accuracy, which is linked to the fact that biometric data is almost impossible to fake or steal. In the banking business biometrics is used mainly to gain access to personal data or in special premises.

The debate over the use of biometric authentication in the banking sector intensified in recent years.

The simplest and most currently widespread practice of client biometric authentication is a comparison of the fingerprint using Touch ID in the mobile bank. Voice Biometrics is especially useful for call-centers, as it allows identifying at a distance, without resorting to the use of special devices.

Prospects of biometrics in banking were recognized by the leading Russian banks. Some innovative banks have already introduced this technology in Russia. Sberbank, Alfa-Bank, MTS Bank, Tinkoff Bank has already implemented the entrance into their mobile apps for fingerprint biometric sensors gadget. Tinkoff Bank launches facial recognition system on the platform of VisionLabs LUNA. VisionLabs Company appeared in Russia in 2012 and began to offer face recognition technology. Then the company Comlogic (2013) and RecFaces (2014) entered the market of biometrics technologies in the banking sector.

Post Bank has already successfully uses biometrics face in the process of making credit decisions and customer service. The system is applied to counter external and internal fraud-when granting credits and authorization of bank employees. The technology allows for the comparison of biometric parameters of the new Bank's clients with the settings already exist in its customer base, as well as compare them with a database of fraudsters.

There are also more large-scale projects. Sberbank plans to abandon the plastic cards and go to the identification of customers by voice and appearance through the 2-3 year. Voice identification system will allow the owner of the account to give voice commands over the phone. Face detection or handprint can be used with personal visits to the Bank or ATM transactions.

Bank of Russia, together with the Ministry of Communications and Russian Finance Monitoring Service create a unified database of biometric data of Russians, which allows to remotely identifying the client through the portal "StateServices". The client passes full identification in any bank. The aim of the project is organization of secure exchange of biometric data between banks. It will enhance the usability of customer service and reduce the cost of attracting new customers, for which no longer require physical presence when opening account, loan or contribution in the new bank.

And this is a global trend. For example, one of the Japanese banks has biometric payment system that allows customers to withdraw money at an ATM without credit card since 2012. Now iris of the eye customer identification is widely distributed by the American banks. Americans also have an opportunity to pay for purchases in shops after passing the Palm vein pattern identification. The introduction of such innovation allows banks to streamline business processes (for example, cut the time of processing loan applications) and effectively combat fraud. This technology is attractive for the customer convenience, as it doesn't require remembering a PIN code or use additional devices and takes less time than traditional methods of client authentication.

Full implementation of biometrics in the banking business involves extensive use of multifactor authentication of clients, i.e. biometrics in combination with traditional methods of client authentication.

Cyber Currency - Money of the Digital Economy

The last hundred years of world history were marked by the rapid development of the financial and banking sector, underpinning the emergence of the so-called electronic money. Many economists think that in the future paper banknotes will be replaced by electronic money. However, the essence of money will remain unchanged, but their form will change. Money move into the realm of virtual reality, become "invisible". The role of electronic money in modern monetary theory is still under debate, but in practice the virtual cash becomes currency in the world economy and its financial markets.

"Glossary of Terms Used in Payments and Settlements Systems" of the Bank for International Settlements (Basel, 2001) defines the payment system as "a set of instruments, banking processes and interbank payment systems that provide cash treatment" A glossary of terms used in payments and

settlements systems. Thus, there is an understanding of the basic elements of payment systems, which, of course, is money.

Transformation of types of money is due to the influence of objective trend of society development. A new money patterns appear only in accordance with economic demand in the process of constant search for more efficient payment systems that save social work, reduce the cost of money turnover, speed up traffic, increase the reliability and convenience of cash flow.

Obviously, the technical and scientific progress contributes to the process of changing types of money. On the one hand, the availability of electronic cash requires developing e-commerce in the Internet, which is a new stage of development and globalization of the world economy. On the other hand, electronic money economizes work, costs less and accelerates monetary circulation in comparison with banknotes and coins. The practical implementation of the idea of electronic money became possible only in the early 1990's, in connection with the development of electronic computer technology, telecommunications, as well as encryption systems and cryptography.

Messages of administrative restrictions on cash circulation in different countries give additional impetus to the development and widespread use of digital currency. Nowadays the topic is relevant to many countries of the world.

It is believed that attempts to remove from circulation the cash will give further impetus to the development and wider spread of digital currencies, in particular, bitcoins. At present, the world monetary system is "drifting" from the system, which unites the national monetary systems, based on national currencies to multi-currency monetary system based on the broad application of advanced information technology and modern computers. Digital currency are actively submitting the world, still arouse intense debate. In some countries these analogues of money is prohibited, while in others, on the contrary, they are used very actively.

The definition of terms is also under discussion. For example, in the Russian-language Internet (Available at: http://www.cryptomap) digital currency is recognized as a type of crypto currency, the issuance and accounting of which are based on asymmetric encryption and use of various cryptographic protection methods, such as Proof-of-work and Proof-of-stake" or as "innovative network payments and a new kind of money, which uses P2P technology, functioning without a central supervisory authority or bank; transaction processing and issuance are produced collectively online". On the website "Crypto Currency News" we can read: "the function of digital currency is no different from other payment systems because it allows you to sell and buy goods and services. Its' fundamental difference from the other means of payment is the way of issuance and organizations of storage and processing payments". In this case, it is obvious that the above definitions need serious refinement and clarification, because the terms "payment system" and "digital currency" are not synonymous and should not be confused.

According to Vakhrushev. D.S. and Zhelezov O.V. (2014), "digital currency is a special kind of electronic money whose operation is based on a decentralized mechanism of issuance and turnover as a complex system of information and technological procedures based on cryptographic methods of protection, governing the identification of owners and fixation of their shifts". However, and this definition of digital currency is not fully consistent with their essence.

Crypto currencies have no real value and do not reflect the real situation in the economy of a given country, as they are international currencies. The idea of creating them is not to create a fully-fledged representatives of real money (such as gold), but their counterpart.

The most important characteristic of a digital currency circulation system is decentralization. It has no single emission center. It does not depend on the banking system. Regulators of financial markets do not control the digital currency turnover.

Bitcoin is just one type of digital or crypto currencies, provided in electronic form. A key feature of it is that it is one of the first the so-called decentralized currencies. Bitcoins are "produced" by their users worldwide.

The first bitcoin in the world appeared in 2008. Its' cost was only 8 cents (0.08 dollar). In 2009 10.000 bitcoins were released into circulation. 6 years later their number had increased to 14 million. It is expected that its maximum (release of 21 million bitcoins) the system will reach up to 2040. The main factors contributing to such explosive growth in the use of bitcoins were: a sharp increase in the number of "miners" on bitcoins market and technological progress, which increase the effectiveness of hashing data when processing transactions.

Currently there are more than 1000 types of crypto currencies. At the end of 2017 the world experienced an excessive demand on crypto currencies, which led to a sharp increase in their value. Bitcoin's rate against the dollar in December 2017 grew to a record $20000. The price of one bitcoin in Russian rubles was approximately 1 million. There are significant fluctuations in the value of crypto currencies. For example, the total crypto currencies market capitalization according to the web-site CoinMarketCap (Available at: http://www.coinmarketcap.com) at the beginning of 2016 was 6.9 billion US dollars. Two years later (on the 01.02.2018) this figure was almost 511 billion, 02.02.2018 - 420.72 and on 05.02.2018-385.45 billion US dollars.

The Bitkoin market share is approximately 35%, Ethereum - 22%, Ripple - 8%. Now Bitcoin and Litecoin are widespread currencies.They are accepted by all the existing exchanges and exchange offices. The other crypto currencies are based on the open code of Bitcoin and essentially are Bitcoin derivatives.

System developers actually replaced the traditional banking system to an alternative in the form of so-called "miners", i.e. instead of the banks in the system for the treatment of bitcoins serve ordinary people, who are interested in getting profits without special efforts. The task of these people "miners" is to download the special program and leave the personal computer open to processes information transactions. A transaction remain anonymous and no one can crack this type of operation, as it registers the operation in the form of a code that consists of 128 characters that Crypto-processed program has and take a new look. Only the buyer and the seller are parties to the transaction, and "miners" are their facilitators. Bank as a financial intermediary disappears during the operation. Each party to the transaction has a personal virtual wallet and key (crypto-code the passphrase) to his bitkoins. The buyer sends the seller your data, the information is stored in the so-called "network sites". Then the "miners" using the program handles this information and store it in blocks (in the form of the transaction log by analogy with the accounting log business transactions). To do this, "miners" solve complex mathematical problem and determine the correct sequence of 128 crypto-characters. "Miners", having equal access to information, compete with each other.

Miner, who can resolve this mathematical problem quicker than any other, gets a chance to connect with block created earlier, and as a reward gets brand new bitcoin. This is a "trick" of the system of bitcoins. The creation of money comes in the form of remuneration for "miners" work. But the complexity of transaction processing is supported artificially. The more "miners" works on the market, the more difficult it is to create a block transaction.

Currently one group of developers believes that payment systems based on digital currencies circulation should fully compete with giants such as Visa and Mastercard. As a result they stand for the radical

increase of the technological parameters of the system in the shortest possible time. Otherwise, they argue, transaction confirmation will take up too much time, which would entail a sharp increase in fees and would result in a collapse of the entire system. Their opponents argue that such actions would entail the loss of independence of this crypto currency, as would inevitably lead to centralize its management. In addition, they fear that the system eventually would become unnecessarily cumbersome. And that would alienate part of its users. For example, the famous financier George Soros called the deal using bitcoins "financial bubble" on the market. One of the founders of the popular English-language site - Bitcoin.com - Emile Oldenburg in early 2018 sold all his bitcoins and stated that investments in this crypto currency were some of the most risky in his life. According to him, people will start to get rid of bitcoins once they will understand how they work. Among the major problems of bitkoins he mentioned high commissions. Indeed, to confirm a transaction now requires nearly five hours that reduces bitcoins' liquidity. However, investments in this crypto currency are very risky. The last limitation is hard to overcome, because bandwidth is limited by the size of the block that contains the history of committed transactions.

Discussion about the prospects of crypto currencies and the possibility of their use in national payment systems in recent years does not only continue, but is becoming more active. Different approaches to the possibility and expediency of their use lead to various practical solutions. Currently we can see various trends in the practice of crypto currencies use in the world.

Despite existing differences, digital currencies continue to explore new markets. And in some countries crypto currencies are actually legalized. According to media reports, for example, Spanish travel agency Destinia has added to its customers a new option - the possibility to pay bitcoins for purchases of airline tickets. Such payments are made on the company's website almost daily. The most active users of bitcoins are its clients from Spain, Sweden, Germany and Argentina.

In Switzerland crypto currencies are used at the level of individual municipalities. South Korea plans to adopt a law on the legalization of crypto currencies. Japan is the only country in the world, where the State controls operations with digital currencies. And these operations are subject to income tax. Russia intends to use this positive experience in the practice of digital currencies. The UK Company Coinbase opened instant purchase of bitcoins using credit and debit cards with 3D secure technology for its British and Spanish customers and thereby provide them additional security payments made via the Internet. Fee is 3% (Available at: https://www.pwc.by/ru/publications/other-publications/edges-blurring.html).

At present, there is a probability of occurrence of state or public crypto currencies. The Deloitte Center for Financial Services Report expressed a proposition that many of private crypto currencies existing now will disappear in the next 5 years. Interests in distributed technology and digital currencies have shown banks worldwide. First in the list of central banks, according to Deloitte, launching their own controlled crypto currencies, can become the Bank of England. The Bank plans to produce its own digital currency - RScoin. It is a type of digital currency that cannot be forged or falsified. Currency model has been developed by the London University College scientists. It is expected that the currency will work like bitcoin. However, it implies the existence of centralized control. The only party in control of the distributed registry will be the Bank of England. It will be able to control the money supply. Unlike the bitcoin with its fixed cash reserve at 21 million, the Bank of England if they wish can release unlimited amount of RScoin currency. But that creates the preconditions for the development of inflationary pressures in the economy.

Another positions adhere to the Chinese authorities, who ban the production of bitcoins. According to the Wall Street Journal (January 10, 2018) Chinese regulator directly points to the need for the country

to cease mining (creation) of bitcoins for consumption of vast quantities of electricity and heating up speculation of virtual currencies. Now almost 80% of the world mining capacities are located in China. That is why their closure seriously affects the global bitcoin market. The Government of India intends to completely prohibit the use of crypto currencies. In doing so, the authorities intend to implement Blok chain for the development of the digital economy.

Restrictions on crypto currencies market also affected investors in South Korea. January 30, 2018 the new crypto currencies trade rules came into force. Now every trader must identify themselves using a bank account.

In contrast, the other countries were taking active steps to promote the practice of crypto currencies traffic. For example, on December 21, 2017 Belarus President Alexander Lukashenko signed a Decree "On the Development of the Digital Economy", which aims to create favorable conditions for the development of finance in the Republic, including block chain and crypto currencies technologies. Meanwhile, the Prime Minister of Belarus Andrei Kabyakou stated that his country was not considering the introduction of crypto currencies in Belarus, and tests the technology "block chain" under "digital sandbox".

Within the framework of the Eurasian Economic Union Belarus offers two important initiatives in the sphere of development of digitalization: 1) the integration of the digital infrastructure of EAEU countries (introduction of uniform standards and overall management of the physical infrastructure, formation of high-grade digital transport corridors in East- West); and 2) the transition from a coherent policy in the digital realm to a unified strategy for member countries of the Union. It is proposed to establish a general program of the Eurasian Economic Union digital transformation with specific actions and timelines for their implementation.

Armenian Prime Minister Karen Karapentian believes that digitalization in modern conditions is the only chance for the country to become a State with efficient management and economy in the shortest possible time. He noted that in his country the annual growth in IT sector is about 25%. By the end of 2017 this indicator was 28%. Armenia has identified six strategic directions for the digital transformation: Digital Government, digital skills, digital infrastructure, cyber security, the private sector and institutional frameworks. In 2017 the Armenian authorities have established the Foundation "Digital Armenia" and have developed a relevant program up to 2030. According to this program 100% of public services for businesses and 80% for citizens must be provided in digital form.

Digital Currencies Market: Security Aspect

In general, crypto currency is a new phenomenon – an element of a fundamentally new monetary system. While the single solution for digital money future strategy in the world does not exist yet, it seems essential that the competitive development of payment systems with a large number of electronic money issuers should be subject to mandatory control regulators of financial markets.

The main advantage of digital currency as a mean of payment is high level of security. Block chain system determines the basis for its sustainability. The absence of an intermediary institution for not only funds transfer, but also to confirm their occurrence in a hashed (encrypted) form, increase the level of confidence in the reliability and security of funds. Reliability of the system is based on the superiority of total power devices by market players over the attackers. But problems appear while moving, for example, to new versions of the software; the ingress of harmful software from the network, etc.

Initially high growth rates of digital currency explain the simplicity of its "production" and the need for major rewards for the first participants taking the risks of participation at an early stage of the sys-

tem. Then, with the growth in demand for digital currency and rising costs on the single unit of crypto currency, emission rate decreases sharply.

Special keys provide transparency and anonymity of the transactions. Any user is able to trace the path of circulation of each currency unit. The digital signature can be specified by email and nickname of the person who conducted the transaction. However, the data is not directly associated with the man, he could remain anonymous. In addition, access to the compromised electronic purses can only be accessed through this proof of identity to a digital signature that verifies the owner of a purse from an attacker.

System by adding timestamps in the course of the transactions registers the chronology of their creation, which largely prevents fraud and demonstrates a way of handling of each currency unit. In addition, the validity of transactions can be easily verified by the system participants. Thus, Block chain sets the sequence of transactions, improves cryptographic strength and eliminates many kinds of fraud.

Bitcoin Vulnerability

Bitcoin network is probably the world largest Block chain project. But, despite the high level of technological protection this payment system has a number of vulnerabilities.

Bitcoin (like any other analog currency) is vulnerable to so-called *"Attack 51%"*. Until the disposal of the attacker are power greater than all the rest of the network, it could not confirm other people's blocks, reiterating only his and means getting 100% of all new Bitcoins and block any transaction in its sole discretion. This threat is only theoretical. In practice it has not occurred. But given the emerging threat technologies could well become a reality and, therefore, protection against these types of Bitcoin attacks is constantly improving.

Bugs may lead to instability in the protection system. That is why the modern versions of Bitcoin for clients have been created, given that they will have to respond to bugs and to correct the mistake in time.

Hackers attack and *slow down time within the network*, which makes it difficult to transfer data, messages between users, updating of information in the network, forming blocks, chains and their commit parties to transactions. Despite the reliable security system, hackers every day improve their attack, finding gaps in protection. Bitcoin Exchanges exposed to hacking attacks, which impeded the work of the system. One of the most common forms of hacker attacks is a DDoS attack, sending a large number of "garbage" data to the node that handles the transaction and may complicate its work. Bitcoin has built-in protection against attacks, but the modern types of attacks are becoming ever harder to block. It is worth noting that the successful hacker attacks lead to strong fluctuations of the crypto currencies' exchange rates.

In August 2, 2016 as a result of the theft of 119756 Bitcoins ($60 mln.) on Hong Kong crypto currency exchange - Bitfinex – Bitcoin rate against the dollar fell by 20% (from $560 to $480 USD per 1 Bitcoin). The trading platform founder Magnr Jo Lee believes that the long-term prospects of crypto currency development are far from flourishing. Traders are watching the Bitcoin course and in the long run it is too unstable. There is, however, a contrary view. Analyst Tour Demister sees no signs that the crypto currency market is full and expects the Bitcoin course to grow markedly.

And although the theft happen less frequently lack for ordinary user the possibility to change something, makes Bitcoin, Ethereum and their analogs not the best investment.

Financial Sector Technological Revolution: Russian Case

According to the last data, Russia ranks among the top 10 countries-Internet users in Europe and is the second after Germany. The results of a recent ESET company study demonstrated the commitment of Russians actively use digital currencies.

Bills on digital assets, issuance and digital currencies circulation are currently under debate. Interaction of mega-projects is being developed with financial market participants engaged in digital currencies transactions. The Central Bank of Russia (CBR) has gradually introduced new rules on the use of digital platforms. For example, a digital platform for the remote client identification was introduced in 2018. It can increase the level of competition in the banking sector, while simplifying the interface and enhance protection of customers' biometric data. At the same time the CBR is working on digital platforms for the fast payments systems (payments by email or phone number), as well as the development of plastic cards payments systems. But while single decision on further development strategy in this area is not accepted, it can be assumed that digital technology can be used for upgrading or developing innovative public payment systems that will reduce costs of treatment increase the speed and security of payment transactions. And because the new payment system, operating on the basis of digital technology, will have the status of a State, they will receive the necessary support and the confidence of the economic agents that eliminates systemic problems of existing private payment systems.

On February 2, 2018 CBR opened the first Russian competence center on combating illegal activities in the financial market. The basic directions of its' work are: identification of market players, working without licenses and entering them into a database; resistance to "financial pyramids", "black creditors", illegal insurance and Forex dealers, the collection of information on organizers of the fraudulent schemes, initiating inspections and applying interventions to offenders.

The use of money surrogates is prohibited in Russia. However, there is fertile ground for decentralized crypto currencies issuance.

RF Ministry of finance published the Bill "On Digital Assets" to identify the status of the digital technologies used in the financial sphere and their basic notions, including crypto currency. According to the document, tokens and other digital assets can be change for rubles, foreign currency, and other property only through operator of digital financial assets exchange. The Bill also limits the amount by which the non-qualified investors can buy tokens in one ICO (placing tokens to obtain financing) - no more than 50 thousand rubles.

According to Aleksei Moiseev, the RF Deputy Minister of Finance, crypto currency exchange for rubles and other assets can be allowed on some territories of the Russian Federation. In particular, the Ministry is currently considering the possibility of implementing the organized trades on the Russky Island and the Island Oktiabrsky, where a special regime can be entered. He stressed that the exchange of crypto currencies on the territory of Russia will be able to solve the task of whitewashing the market. However, the Ministry of Finance and the Bank of Russia has not yet agreed on the exchange of crypto currency in rubles and other assets. According to the Central Bank of Russia, such transactions should be allowed only in respect of tokens. The Ministry of Finance in turn emphasizes that it does not involve the use of crypto currencies as legal means of payment in Russia. Nowadays the Ministry of Finance is finalizing a draft law, which will define the concept of "cash surrogates" and establish responsibility for their use as a means of payment. This is necessary to protect the ruble as the sole legitimate settlement funds in Russia.

Premier Dmitry Medvedev proposed a legal regulation of digital money at the level of international conventions at Forum "Digital Agenda in the Age of Globalization" in Almaty on February 2, 2018. In his view, block chain technology have a tremendous future. And it is hard not to agree.

In September 2015, Russian mass media disseminated information about the possible issue of the first RF virtual currency - Bitruble. Qiwi payment system stated that it is ready to launch crypto currency Bitruble provided that agree with the Central Bank of the Russian Federation on this issue. Company «Yandex.Money" is also interested in participating in transactions with crypto currency if it will be allowed by the Bank of Russia.

At the same time regulators have repeatedly reiterated their misgivings this payment tool. So, on September 17, 2015 Chairman of the Bank of Russia Elvira Nabiullina said on the Forum of innovative financial technologies "Finnopolis" that the Russian mega-regulator of financial markets will continue to examine the question of the treatment of digital money and use of crypto technology in the view of accompanying risks:

- possibility of carrying out suspicious transactions. Use of crypto currencies, which can be redeemed for real money, carries risks in the field of combating money-laundering;
- Russians in general are not well informed about the details of working with digital money. People do not always realize that accumulating bitcoins may lead them to lose their money because they are not insured by a deposit insurance agency;
- CBR, as Mega-regulator of financial markets, could lose control of the money supply, which is fraught with grave economic and political consequences.

Deputy Finance Minister A. Moiseyev reported that the RF Government is going to discuss the draft law (on crypto currencies), but given that the world's standards for the treatment and management of crypto currencies does not exist yet, in these circumstances, start to regulate this field has meaning only in case of the "stable world practice". The Finance Ministry believes that the Russian authorities should be wary of the emergence of crypto currencies in Russia, because they bear the risks in terms of money laundering.

French legal experts and employees of one of the largest banks Dominique Burrine and Ethier More demonstrate a similar approach. Because currently, the international legal status of bitcoins is not defined, it is not possible to include this type of tool to any financial categories. Bitcoin is not currency. It does not have an exchange rate. It is not a mean of payment and not even the electronic money (according to legislation of many States). However, such uncertainty does not prevent some market players use crypto currency as a product of the risky financial instrument. The absence of crypto currency regulation does not give their owners any guarantees regarding prices and liquidity. Moreover, users are not protected from even bitcoins' simple technical failure. In this regard, their proposal to develop the international legal framework that would regulate the treatment of bitcoins and other crypto currencies, was published in the specialist magazine "Les Echos", deserves attention and support.

However, digital money is located at the intersection of two technologies - financial and information. Recently it became known that the IBM Corporation, one of the largest technology companies, opens block-chain laboratory. The company plans to use large computing power to determine possible potential of cyber currency. It is assumed that the lab will simulate cyber currency practical use cases, ranging from payment applications and to the possibility of money laundering. The creators of the laboratory

intent to develop open standards for the use of block chain technology in the field of financial services; it will be a breakthrough for introducing crypto technology for the payment systems mass market.

Deloitte Consulting firm analytics among the factors that have an impact on global financial markets in the coming years, along with demographic, consumer and other factors referred to the development of artificial intelligence, neural networks, block chain and crypto currencies. Deloitte Center for Financial Services (2015) qualifies block chain as "perhaps the most important innovation of all", considering that the technology has the potential to change the payments market, which is estimated at 26 trillion US dollars each year. Changes that can provide block chain are speeding transactions, reducing transaction costs and eliminating intermediaries. Deloitte predicts that private block chain will also spread, particularly through the banks.

Block chain payment systems should significantly increase the volume of transactions to 2020, while the proliferation of other systems on the basis of this same technology becomes a reality closer to 2025. Deloitte assumes that "probably Bitcoin and other digital currencies will dominate". But their widespread adoption lacks two factors: availability of compatibility between block chains and compliance with global regulatory standards.

But while single decision on further development strategy in this area is not accepted, experts have suggested that existing differences can eventually lead to the emergence of new digital currencies and even started talking about a possible collapse of Bitcoin, because the transactions are anonymous; and their turnover until recently was not regulated in any way.

Crypto technologies can be used for upgrading or developing innovative public payment systems that will reduce the costs of treatment increase the speed and security of payment transactions. And because the new payment system, operating on the basis of crypto technologies will have the status of a State, they will receive the necessary support and the confidence of the economic agents that eliminates systemic problems existing private payment systems based on digital currencies.

Given that payment systems are usually intended to achieve specific operating and economic performance, it is important to highlight their basic elements that require special attention: a formal agreement between members of the system; agreed and accepted technical standards and methods of payment orders circulation between participants; concerted clearing procedures, claims of the participants and resolving liquidity problems; general procedures and work rules, including timetable, criteria for participation, commission rate, etc.

In countries with advanced economies, stable monetary systems and traditional banking, crypto currencies will occupy a niche in which their use is most effective. In developing countries with young and until unsustainable monetary system the need to maintain tight control during their implementation is of great importance. For example, a huge territory of Russia, relatively cheap electricity and a high level of education of the population and other factors allow to the experts to consider the question of creation in Russia an International Financial Centre of Cyber Currencies.

Progress has placed new demands on the economy and the existing payment systems. Distribution of payment systems on the basis of cyber currencies is reality now. Financial regulators around the world are currently working on mechanisms for their implementation in a traditional payment system, which would enhance its efficiency and competitiveness. However, cyber currencies obviously will find its rightful place in the global payment system only in case of the effective adoption of new digital technologies (including block chain), while retaining control of financial markets at the national and international levels.

SOLUTIONS AND RECOMMENDATIONS

Digital transformation in financial intermediation shows the possibility to "survive" to finance-credit institutions, which would be receptive to technological innovation, maintain financial stability and will focus on the client. In other words, the business model of these financial intermediaries will become competitive.

However, major Russian credit organizations, which belong to the cluster of systemically important banks, favorably differ and not slow on its equipment and advanced in technology and information from Western institutions. At the same time a sufficient number of small-scale banks do not have sufficient resources for technological innovation. This does not mean that banks will not be able to overcome the challenges of the digital revolution. Effectiveness of customer-oriented banks' business models will be determined by modern channels of financial products delivery, their selection in accordance with customer needs, responsive to price dynamics.

FUTURE RESEARCH DIRECTIONS

Analysis of current practice and prospects of development in financial sphere, taking into account the results of sociological surveys show that the innovative business model of modern credit institution in the context of digitalization of the economy is one the promising future research directions.

Analysis of factors and trends of development of the global and the Russian economy as its integral part is the basis for the scientific understanding of the situation and to propose specific steps to bring the Russian economy on the rails of new industrialization and ensure its optimal stable growth and development. To achieve this, it is necessary not only to conduct scenario analysis, but also to develop a specific plan of action in the light of (at least): elaboration of a theoretical framework, methodologies for solving tasks, determine the necessary tools to ensure organizational and administrative, managerial and institutional solutions. Scientists and practitioners need to build a strategy for socio-economic development of Russia on a qualitatively new level, taking into account the lessons of the global financial and economic crisis, as well as the latest trends of world development.

The competitiveness of the banking system and the economy as a whole depend on the ability of the system to provide high-quality and adequate to the value of financial intermediation services for all Russian economic agents of large and medium-sized businesses to small businesses and individuals.

CONCLUSION

Despite all the advantages of rapid technological innovations development for banks, fintech companies' and their customers, there are still many blank issues that should be discussed. The business model of the modern credit institution in the context of digitalization of the economy is one of these problems. The authors do not share views of those experts, scientists and businessmen, who predict for banks in the context of digitalization losing their market share and field of action as a result of fintech companies' competition. First, the significant risks remain. The majority of these risks are not defined yet and, consequently, possible loss is underestimated. Secondly, the majority of customers, especially in developing economies are stick to conservative behavior and prefer to work with monetary institutions. Thirdly, most

countries in the world do not have sufficient financial resources. Moreover, there is evidence of the debt pressure growing. Fourthly, the problem of security for crypto currency transactions and operations will be one of the key. No coincidence of national regulators in different jurisdictions in accordance with new standards activities of the expanded list of operational risk, include cyber risks. Forming methodological and technological maintenance of accounting and evaluation of the risk impact is only in its infancy. However, banks' practice of distance work with their customers commits considerable losses. In this regard, the early recognition of this situation, from our point of view, will slow down the rapid use of financial technologies that will create conditions for reformatting the business model of banks, which will become more secure and familiar to the customers.

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KEY TERMS AND DEFINITIONS

Biometric Authentication: A procedure for verifying the identity of the person on its physiological and biological characteristics.

Digital Currency: A type of electronic money whose operation is based on a decentralized issuance and turnover as a complex system of information and technological procedures. Digital Currency or Crypto currency has no real value and do not reflect the real situation in the economy.

Financial Intermediation: A mediation service for financial and credit organizations' customers.

Financial Market: A market in which carries on a business of financial-credit institutions.

Fintech Company: A modern company functioning on basic principles of new information and finance technologies.

Innovation: New approaches, techniques, tools.

Technological Revolution: A modern industrial and technological revolution is known as "digital revolution" – mass introduction of big data and computer technologies.

Chapter 6
Industry 4.0 as a New Disruptive Concept in IT Management and IT Governance:
Vision and Future of the Industry 4.0 Concept

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ABSTRACT

This chapter is going through the Industry 4.0 concept. On the first hand, it relies on advanced technologies which have a high potential to save costs and deliver groundbreaking products and services. On the other hand, Industry 4.0 brings so many innovations and opportunities that it requires an essential change in thinking and organization. Presented insights are based on conducted comparative analysis and its results. This analysis compared significant maturity models for the assessment of Industry 4.0 readiness in organizations and defined universal dimensions. These identified dimensions uncovered existing gaps in the analyzed maturity models. Solving these missing areas required additional research that provided additional insights not only in Industry 4.0. The results of this analysis provided an overview of critical factors related to Industry 4.0 and possible solutions to missing parts. The technical challenges related to technologies, standards, and architectures used in Industry 4.0 are introduced. Organizational specifics of this concept are outlined.

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INTRODUCTION

A current digitalization trend and related Industry 4.0 concept are important drivers in today's profit and non-profit organizations. Everything is getting smarter, faster, more intelligent, and more automated. Sometimes, it is possible to see ideas of products and devices which were known in sci-fi only a few years ago. Recent advancements in science enable new ways and possibilities in the life of people.

The digitalization trend represents and includes a lot of things. There are already elaborated plans of smart cities which use massive automation solutions for the improvement of everyday tasks like for instance traffic control or energy distribution. Known are also intelligent eGovernment solutions that decrease time spent in queues and make bureaucratic acts easier for common citizens. In the private sector, smart households are popular because everybody wants to show turning lights on and off to their friends at a bus stop. All these concepts and many others can be classified as a part of the digitalization trend. They are often hidden behind names like Government 4.0, Health 4.0, Farming 4.0, Business 4.0, or Industry 4.0. Industry 4.0 was one of the first defined concepts related to the digitalization trend and this concept is the main topic in this chapter.

Industry 4.0 brings new opportunities to organizations that operate in various industries - from drilling and mining to mass-production and high-tech. However, this concept primarily aims at manufacturing companies that look for a new way on how to optimize their production, processes, and daily tasks. It is also the reason why these companies are investing in research in this area. Industry 4.0 is not only used technology but at least in manufacturing, it represents the most advanced synergy between the business strategy and technical capabilities of available technologies. The main general vision of Industry 4.0 involves two main elements: smart factories and smart products. Smart factories are capable of drastic saving of costs via high flexibility and optimization of production. Smart products should ensure high sales thanks to their high attractivity and accompanying services attached to them which generates additional revenues.

But the building of a smart factory and designing of a smart product are not simple tasks. In fact, it is quite difficult. And it is also the reason why such attention is paid to Industry 4.0, research is so interesting, and this chapter was written. This chapter summarizes the concepts and ideas related to Industry 4.0 in manufacturing. How does it influence the organization and what is it required from this organization, its IT department, and its management team? What are the opportunities, challenges, specifics, and issues of Industry 4.0? What is Industry 4.0 in manufacturing? Just these questions, this chapter is trying to answer.

Background

In the professional and scientific literature, Industry 4.0 is often compared to the fourth industrial revolution. This comparison represents this initiative as a major shift in the perception of development -Industry 4.0 is understood as an important milestone. At the same time, the number of different perspectives, definitions, or approaches is high, and this fact leads to the increasing complexity of the topic. Within introduced concepts, many various terms and abbreviations are used. For better understanding, the author provided definitions of these abbreviations and terms within footnotes in a simple form of own words.

It means that the perception of this initiative varies in the articles, whitepapers, and even in professional literature. It is possible to find studies which attempted to grasp this topic in a holistic manner. A study focused on fundamentals of Industry 4.0 is (Roblek et al., 2016). This study defines essentials concepts

like: smart factory and smart manufacturing, new systems for development of products and services, self-organization in manufacturing and supply chain, smart product, new systems for individualization of distribution and procurement, adaptation to human needs, CPS[1], smart city, and digital sustainability with focus on resource efficiency; and important components which include: IoT[2], IoS[3], Big Data[4], integration with systems like ERP[5] and CRM[6] systems, communication via M2M[7], and etc. Because it is important to keep these elements organized, this study also proposes to maintain a knowledge base which places these elements into relationships and reasonable context.

This study can be also perceived as a general overview of Industry 4.0 and it is possible to use it as a starting point for the following research or interesting topics. In the current state of Industry 4.0, one of the main elements of proposed or existing solutions is CPS. Authors (Trappey et al., 2016) uses the same presumptions as (Roblek et al., 2016) in the area enterprise systems integration and describes CPS as the main orchestration component within the solution. The article (Trappey et al., 2016) also characterizes smart manufacturing systems as intelligent and autonomous systems which require synchronization to produce products of high quality, the possibility of variety, with the maintenance of low costs, and satisfaction of diverse consumer demands. This definition is satisfying the requirement for a brief but reasonable illustrative description of Industry 4.0 and its main goal in the manufacturing. But, CPS is a universal description or element. In the context of manufacturing, it is possible to find other concepts which are based on or replaces CPS. Often, a term MES[8] is used.

MES is also presented as the central orchestration point in distributed collaborative systems. Publications (Dobrescu et al., 2016; Ferrer & Lastra, 2017; Muller et al., 2017) describe MES as a key element which manages all operations in Industry 4.0 solutions. In manufacturing, MES is defined as an extension built up around CPS or it is defined with similar functions as a replacement for CPS. It is a cause of complexity in Industry 4.0. There are defined terms which may look as different or specific, but they may describe a known concept under changed circumstances. It is the reason why it is important to pay attention to definitions and traits of used components.

Available publications are also elaborating the approaches to implementation and architecture of Industry 4.0 solutions. Industry 4.0 is often related to MAS[9]. It was already mentioned that the concepts used in Industry 4.0 are distributed. There are used central orchestration components, but every involved element needs some level of autonomy (Cagnin et al., 2018; Dobrescu et al., 2016). MAS is a modular concept and the situation as similar as in the case of CPS. There is a concept MPS[10] based on MAS which is defined specifically for manufacturing. Articles (Friedrich et al., 2015; Shinohara et al., 2017) uses MPS as an answer to the requirement for modularity and flexibility.

Every independent component is in MPS represented by an administrative shell (Friedrich et al., 2015; Shinohara et al., 2017). The administrative shell is an agent which provides a universal descriptor of the underlying hardware or asset (Bedenbender et al., 2017). Considering the implementation, architecture, modularity, and universal descriptors of independent elements, it is only one step from the SOA[11], a concept that can be perceived as the solution for modularity and flexibility of Industry 4.0 technical realization (Dobrescu et al., 2016; Ferrer & Lastra, 2017; Muller et al., 2017).

There are not any doubts about the importance of technical elements in Industry 4.0, but Industry 4.0 is very a business-centric concept and also economical and organizational elements are important. As one of the most important traits of Industry 4.0 must be mentioned the multidisciplinary nature of Industry 4.0. There are areas in Industry 4.0 which are out of the capabilities of IT like identification of opportunities or determination of the competitive position (Ganzarain & Errasti, 2016; Lichtblau et al., 2015). Another perspective, economical, is also under the process of rethinking. There are studies

which evaluate advanced and more sophisticated economic and financial methods for use in IT. Articles (Festa et al., 2015; Wu et al., 2015) introduce replacements of the methods ROI[12], ROE[13], and NPV[14] by methods BSC[15] and EVA[16]. Models presented in these articles are presented in the way that they should be involved in the planning phase of the IT implementation projects as an integral part of the financial perspective. All these discoveries are gaining a higher relevance in the context of Industry 4.0 due to its engagement in the economic plans of the organization.

Considering the financial perspective, the important breakthrough is described in the research of (Saunders & Brynjolfsson, 2016). These authors are describing in their research a concept of intangible assets in IT. There are introduced several groups of IT-related assets which have defined properties like depreciation rate or they can be valued using common valuation methods. An important output of this research is also a definition of the relation of these IT-related assets and the balance sheet. But when the IT capabilities are considered as assets, they can be handled as regular resources of the organization and can be used as elements in the strategizing process (Wit & Meyer, 2014). One of the main outputs of the strategizing process is a business model. Business models are powerful tools for the added value definition via the value proposition (Osterwalder et al., 2010; Wit & Meyer, 2014). Business models have own life cycle (Osterwalder et al., 2010), in the combination with IT-related assets as key parts of the business model, are providing an insightful perspective on the business-IT alignment in terms of harmonization of activities on the IT and business sides (Simetinger, 2018a) and overall redefinition of financial management concept in IT (Simetinger, 2018b) with integration of modern financial methods.

Regarding the multidisciplinary nature and exposition of Industry 4.0, it is interesting the research effort of consulting companies and prestigious business schools in leadership and openness to innovations areas in the digitalization trend. These areas are completely new topic as Industry 4.0 is getting real shapes and organizations are starting with the realization of Industry 4.0 projects. A series of articles based on analysis of real situations was published in McKinsey Quarterly magazine. Description of the shift in understanding of internal processes and culture opened for change is in (Koller et al., 2018). These authors explain the benefits of dynamic reallocation of the resources which were available within the original strategic plans in different initiatives. Their research discovered that companies are not willing to change the original plans and it leads to the lack of flexibility. Such reallocation requires a specific technique which is described in (Koller & Lovallo, 2018). This technique requires a combination of intuition, expertise, and experience for proper assessment of the required changes. It is needed to consider internal and external influences, and the technique is based on the application of analogical cases which help with the estimation of the adaptation to changes. Regarding the reluctance to changes and lack of flexibility, the research focused on their causes and origins was conducted. In the book (Edmondson, 2019), the concept of psychological safety is described. This concept is also based on the analysis of real situations and circumstances which did not lead to taking risks or starting experimental initiatives. As one of the main factors, the punishment policy in the case of failure is mentioned. The companies which have a higher tolerance to the failure in the case of experimental projects and the responsible persons are not heavily (or fatally) punished in the case of failure, reports a higher level of overall innovations and openness to changes. The explanation is that this environment in combination with appropriate education and training are bringing up highly motivated, resourceful, and innovative individuals. The topic of new ways how to hire people or promote them is elaborated in the book (Chamorro-Premuzic, 2019). The author describing techniques on how to distinguish talented individuals with the potential to leadership roles from the adepts hidden behind the mask of overconfidence.

An emerging topic is also the role of the cloud in the Industry 4.0 concept. In relation with the manufacturing environment, the following terms can be found: cloud manufacturing (Kubler et al., 2016; Tao et al., 2017; Thames & Schaefer, 2016) or cloud-based manufacturing (Pisching et al., 2015). The recent research elaborates the possibility of cloud-based component involvement within Industry 4.0. In the cloud-based manufacturing paradigm, as the underlying concepts are mentioned CPS (Pisching et al., 2015; Tao et al., 2017; Thames & Schaefer, 2016) and SOA (Kubler et al., 2016; Pisching et al., 2015; Tao et al., 2017). In compliance with the results mentioned above, CPS and SOA concepts enable the flexibility and modularity of Industry 4.0 and in cloud-based manufacturing, it means involvement of various components available in the cloud. At the same time, the involvement of the cloud brings new critical topic - a security (Kubler et al., 2016; Pisching et al., 2015; Thames & Schaefer, 2016). The measures for security and assurance in cloud-based environments are discussed in (Svatá, 2014). There are mentioned different frameworks for use in the cloud and different approaches to the execution of the assurance which also include the special variant of BSC. Regarding assurance, the important element is the quality of IT services. It is usual to use SLA[17] for the definition of expected quality metrics, rules, and policies in the case of violation of the SLA. Using cloud-based services requires new elements in SLA (Rizvi et al., 2017). Such elements may, for instance, cover requirement for industry-specific standard or norm which the user of cloud service requires. With SLA is also related need of auditing and in this case on both sides - on the user's side as well on the provider's side. Incorporation of new methods of auditing in this cloud-based environment is elaborated in (Razaque & Rizvi, 2016, 2017).

THE MAIN GOALS, TRAITS, AND CHALLENGES IN INDUSTRY 4.0

In general, it is possible to say that Industry 4.0 represents a redefined relationship between information technology (IT), operations technology (OT), business, and their mutual organization and it requires new perspectives on the use of business informatics resources in the context of business needs. In other words, Industry 4.0 magnifies and strengthens competitive advantages because opportunities can be seized more effectively. But as it is mentioned in the literature review, this topic is not simple to grasp and there are gaps which must be solved individually.

The existence of these gaps is the reason for the creation of various Industry 4.0 maturity models which can help with the finding of possible ways how to overcome the gaps and avoid unnecessary risks. At the same time, the number of available Industry 4.0 maturity models is high and this number is continually growing. As a side effect, the original purpose - bringing of solutions, was replaced by even increased complexity and chaos. As it is mentioned in the literature review, it is possible to find different names for the same or very similar things. And a similar situation is with Industry 4.0 maturity models. The models are describing, explaining and solving the topic of Industry 4.0 with different approaches, vocabulary, elements, structure, etc. These conditions created an environment for a new subarea of the Industry 4.0 research - comparison and aggregating of different Industry 4.0 models into more universal concepts and models.

The Preceding Research

The main input for the author's research was a study from (Basl & Doucek, 2018) that had identified and published a list of significant maturity models for analyzing the preparedness of organizations for

Industry 4.0. The main goal of this research was the identification of key factors and their influence on the realization of the Industry 4.0 principles. The whole research process can be divided into the following steps.

Via a simple excel sheet matrix, these identified models and their elements were via pairwise comparisons organized and compared according to their dimensions, tasks, actions, proposals, and focuses. The identified overlaps defined the shared clusters of traits (actions, tasks, etc.) of all models. Very interesting was the fact that there were also additional model-specific unique traits that magnified the differences between models. However, at this stage, the general overlaps were important.

In the next step, the identified clusters were compared with the estimated generic dimensions in the study from Basl to evaluate their suitability. In combination with findings from the previous step, it was possible to define key dimensions for general use. That resulted in the introduction of an updated list of dimensions important for Industry 4.0.

Besides the defined new universal dimensions, there were also highlighted current issues of the Industry 4.0 realization and some additional insights. It involves structural dependencies and relationships between these dimensions and their relationship to identified key areas. These relationships and key areas then represent a general development roadmap for companies. At this stage, the unique model-specific traits had their role. The variability of the analyzed models provided clues for finding suitable solutions for otherwise missing parts in the universal dimensions.

The Maturity Models in Industry 4.0 and Their Comparison

The study prepared by (Basl & Doucek, 2018) and followed by (Simetinger, 2019) had defined the set of significant Industry 4.0 maturity models and then conducted the comparative analysis of these maturity models. The identification of the significant Industry 4.0 maturity models was based on a literature review and it was also considered their relevance in terms of implementation frequency. During the comparative analysis, it was discovered that even between these defined significant maturity models are chosen maturity models based on some previous comparative research or they are based on gathered recommendations from the government. Some of them were even removed from the analysis because they were not maturity models. They were much closer to technical guidelines for other maturity models already involved in the analysis. The list of analyzed Industry 4.0 maturity models is the following:

- RAMI 4.0 - The Reference Architectural Model Industry 4.0
- Industry 4.0 Component Model
- IMPULS - Industrie 4.0 Readiness
- SIMMI 4.0 - System Integration Maturity Model Industry 4.0
- APM - Asset Performance Management Maturity Model
- Industry 4.0 Readiness Evaluation for Manufacturing Enterprises
- Digitalization Degree of Manufacturing Industry
- Three stage maturity model in SME towards Industry 4.0
- Roadmap Industry 4.0
- Industry 4.0-MM - Assessment model for Industry 4.0
- M2DDM - Maturity Model for Data Driven manufacturing
- Maturity model for assessing Industry 4.0 readiness and maturity of manufacturing enterprises
- Industry 4.0/ Digital Operation Self Assesment

- The Connected Enterprise Maturity Model
- Firma4.cz - Hodnocení digitální zralosti firmy
- Pathfinder 4.0
- acatech Industrie 4.0 Maturity Model

During the analysis, the used dimensions, tasks, activities, and terms from all these maturity models were compared and grouped into clusters. Every analyzed maturity model was then assessed from the perspective of these clusters. The assessment distinguishes three main levels of cover. The first level was full cover when the cluster was covered by the model in similar scope, deep of detail, and the highest level of maturity. The second level was partial cover when the cluster was not covered by the model in all three traits as in the full cover. The last level was none cover which occurred when the cluster was not considered by the model at all. The result of this assessment is visible in Figure 1.

Figure 1. The covering of clusters by the Industry 4.0 maturity models
Source: (Simetinger, 2019)

Clusters	Full Cover		Partial + Full Cover	
Business-IT Alignment	12	86%	14	100%
Competitive Position	7	50%	9	64%
Processes	13	93%	14	100%
Corporate Governance (including security)	9	64%	10	71%
Investments & Economy	7	50%	11	79%
Smart Products	13	93%	14	100%
Customers	12	86%	12	86%
Partners	12	86%	12	86%
Business Model	11	79%	13	93%
Leadership	6	43%	13	93%
Management	13	93%	14	100%
Corporate Culture	8	57%	11	79%
Skill Management	7	50%	9	64%
Training & Education	5	36%	9	64%
IoT/Sensors	12	86%	14	100%
Infrastructure/Communication	12	86%	14	100%
Data Analytics & Integration & Management	12	86%	14	100%
Service-orientation	4	29%	11	79%
Smart Factory	13	93%	14	100%

Figure 1 shows summarized results with the number of models with full cover and aggregated number of models with full and partial covers of the clusters. The results of this comparative analysis are indicating the prevailing aiming to technical topics of the maturity models. Especially clusters of

activities and tasks which solve economic, human resources, and leadership related topics are moved to background a little bit.

The Emerging Issues According to the Comparative Analysis

During the comparative analysis, the clusters were organized within the defined shared universal dimensions. These dimensions are covering technical and not-technical elements that important from the Industry 4.0 perspective. The reorganization is following:

- Strategy
  - Business-IT Alignment
  - Competitive Position
  - Processes
  - Corporate Governance
  - Investments & Economy
- Value Chain
  - Smart Products
  - Customers
  - Partners
  - Business Model
- Organization
  - Leadership
  - Management
  - Corporate Culture
- Human Resources
  - Skill Management
  - Training & Education
- Technology
  - IoT/Sensors
  - Infrastructure/Communication
  - Data Analytics & Integration & Management
  - Service-orientation
  - Smart Factory

As it was mentioned, the clusters are not separated and independent. The situation is the opposite. There are logical dependencies and relationships. In the preceding research, they are called structural because they influence various parts of the organization as it is obvious from their list.

A very illustrative example of such structural dependency is the Business-IT Alignment cluster. This cluster has a quite high coverage – 86%. On the other hand, this one cluster is related to other clusters with much lower coverage according to the comparative analysis. This particular cluster impacts, together with Corporate Governance and Investment & Economy, the cluster Competitive Position. In this case, they are all in the dimension Strategy. But, the Business-IT Alignment cluster also impacts the cluster Business Models that is in the dimension Value Chain. The reason for this is the fact that IT resources are an integral part of modern value propositions and the Business-IT Alignment cluster has a direct

impact on the form of these IT resources. This shows how serious issues are in the existing Industry 4.0 maturity models and there are even more. In the following text are described the most critical inconsistencies caused by identified gaps.

The Resurrection and Renaissance of SOA

A specifical is the Service-orientation cluster. In this case, maturity models that mentioned SOA directly gained the full cover. But if the partial cover was considered, the total cover reached 79%. It means that the majority of maturity models did not mention SOA directly, but a significant total number of the maturity models are using service-oriented ideas and recommendations which are in compliance with SOA principles as they are summarized in (Simetinger, 2012) or defined in (Erl, 2005, 2008). This discovery is supported by the available literature which indicates the importance of SOA. SOA is perceived as a possible answer to the many issues and complexities which occurred together with Industry 4.0 and related concepts.

SOA as the concept was a hot topic several years ago, but it faced several challenges which were not easy to overcome and solve. SOA was introduced as a solution for building of complex and easily extensible enterprise systems with high flexibility and economies of scale. On the other hand, the initial stages and first projects had a heavy burden in the form of difficult administration and high costs that were causing the declining interest of stakeholders. However, the support from the management's side was essential for success. SOA was then replaced by microservices later on which had the technical advantages but without the burdens mentioned above. At the same time, microservices have their own drawbacks and limitations and are intended as a possible technical realization without impacts to the rest of the organization as SOA. Now, the literature review shows that SOA is in own renaissance era. Industry 4.0 and its requirements for flexibility and modularity helps to SOA to be a relevant concept again and in the case of Industry 4.0, the important drawback has disappeared - the support of management. Because the Industry 4.0 is initiated by the business and planned investments are high, the opportunity for SOA is opened. SOA, directly or indirectly, can be the main architectural concept for designing and construction of Industry 4.0 solutions.

In the simplest form, the SOA service represents a defined business process with a set of services which are used within this business process. As it is described in the study (Simetinger, 2012), the involved services can be based or deployed on different technologies and environments but they are able to interact with the process or other services via the standard interface, common communication channel and can be invoked via universal discovery mechanism. This premise corresponds to the expectations of MAS from the literature review. It is the reason why the SOA is considered as one of the main favorites in the question of the Industry 4.0 solution architecture. SOA provides approaches to the construction of flexible modular systems and at the same time, it ensures appropriate alignment with business via involvement of business process in design.

However, the main issue here is the needed to prepare for SOA. SOA is especially about the organization, management, governance of services, and communication with the business. In this case, an organization has to make several key decisions if it wants to use SOA as the main concept. These decisions involve organizational tasks, over suitable frameworks, to optimal technologies for its realization.

The Cultural Shift in Industry 4.0

The question of the alignment with the business processes, or business-IT alignment, is its own topic. Business-IT alignment is an underestimated discipline with the increasing importance in Industry 4.0. As it was already mentioned, Industry 4.0 is a business-driven initiative because it must strengthen the competitive advantages. The comparative analysis shows that business-IT alignment is covered well, but the clusters with leadership, corporate culture, and economic perspective are put side. The issue is, that these areas are related. This fact indicates, how the multidisciplinarity is affecting the nature of tasks in the shared dimensions of Industry 4.0.

The increasing role importance of the business-IT alignment is the reason for the reworking of financial and economic perspectives of IT management and also using business models in IT. Introduction of more advanced economic methods, as it is described in the literature review, is based on the need to move economical metrics used in IT to procedures commonly used in business. The intended goal of this move is a redefinition of the partnership between IT and business. IT must move from the position of support business unit to the position of a real partner for business. In other words, IT should not be only a business unit which allocates its capacities to projects and activities, but it should have space and authority for the creation of own strategic development plans. It needs to replace the allocation of resources to more sophisticated price generation methods with consideration of additional resources for the development and innovations. These resources are based on the margins in prices for IT services and they provide the space for experimental, innovative and development activities. This is the purpose of the advanced financial methods and economic analysis in the process of defensible price generation with sufficient margins. The redefinition of the relationship between IT and business can be also supported by using business models. IT can act as a key partner in the business models of the organization or can offer IT services which are backed up by own internal business model. Then such IT service acts as a key resource in the main business model of the organization.

In this case, the main issue is the redefinition of the IT role in the organization. The usual model when IT is perceived as a cost centrum has to be transformed into a strategic partnership where IT acts as a profit centrum.

The Effectiveness of Management and Leadership in Industry 4.0

However, this transformation has important conditions and one of them is also the switch in thinking of people. It is important to provide the space for innovative and experimental activities which are according to the literature review the main driver for openness to changes. But it is only one, and easier, half of this problem. The more difficult is the second half which requires the much higher engagement of soft skills like emotional intelligence, effective negotiations, an arrangement of trade-offs, etc. In this phase, it is not possible to simply implement some methodology and expect immediate results. It is needed to really raise leaders and slowly educate employees and coworkers. This process is described in the book (Covey, 2009) which describes how to build up the trust and mutual feeling of common purpose in the organization between people. But the question of effective leadership is its own subject of an intensive research discipline. On the other hand, the importance of engaged people is considered in the one analyzed Industry 4.0 maturity model. The maturity model Roadmap Industry 4.0 explicitly uses the step, when the employees directly involved or affected by the change process are part of the discussion and their opinion/decision/proposal has high priority for the final shape of the solution (Pessl et al., 2017).

Despite the progress in the research of Industry 4.0, it is possible to conclude that the actual main problem area is not technology, but pain points are in management and leadership. Indications point to the remaining issues in the leadership and organization. It can be also concluded according to the results of literature analysis, comparative analysis, and also summarizing comments in the previous text. Available technologies are in the development quite far ahead, but organizations are struggling with the fulfilling of the Industry 4.0 main goal - effective using of the advanced technologies for the strengthening of competitive advantages.

The effective identification of opportunities and definition of strategies on how to seize them are directly dependent on the leadership effectiveness and culture opened for changes and innovations. During the analysis of the Industry 4.0 maturity models, it was possible to spot an important point in every maturity model. This point defines a logical milestone when the different dimensions cannot be moved to a higher level of maturity independently. This point is usually somewhere behind the second third of maturity levels. From this point, it is necessary to increase the overall maturity of the solution in more dimensions simultaneously.

The dimensions Organization is the main subject in this issue. Enabling of true innovative culture in the organization is the main requirement for the rest of goals in Industry 4.0.

The Vision of the Cloud-Based Manufacturing

The comparison of the highest maturity levels in the Industry 4.0 maturity models shows the vision and future of Industry 4.0. Those are based on a massive usage of cloud services and building of dynamic and distributed supply chains. The incorporation of cloud services has two perspectives. The first one is the consideration of available services in the cloud and how can they enhance the Industry 4.0 system. The second one is the determination of the impact on the compliance and assurance of the Industry 4.0 system if the cloud services are used.

These two dimensions are counterparts which affect each other. The more cloud services are integrated into the Industry 4.0 solution, the more variability, flexibility, efficiency, and other benefits can be achievable. But at the same time, the more cloud services are used, the more complex additional tasks are needed to keep the Industry 4.0 solution compliant with norms and standards. This issue is described in the study (Simetinger, 2018c). This study refers to some general paradigms which are used in the cloud-based manufacturing concept. Initial stages of this concept can be even based only on the cloud storages (Pisching et al., 2015; Tao et al., 2017) or there can be used CAD[18] application in the cloud (Kubler et al., 2016; Thames & Schaefer, 2016). In the cloud-based manufacturing solutions can be also used analytical applications in the cloud (Tao et al., 2017). Even this simple list indicates that the main focus is on PLM[19] and its support. The idea is the creation of CAD models securely stored in the cloud storage and used in the production process with intensive monitoring via data analytics and coordination from the ERP system.

In limitless imagination, the possibilities of the combinations of cloud-based services with in-house hosted applications are also limitless. But as it was discussed earlier, the cloud services are bringing some issues. There are industry-specific norms and the cloud providers who want to provide the services to such industry must be able to meet the criteria of these norms. Or the new legal requirements like GDPR[20] or the location of where the data are stored. All these factors (and many others) are affecting the conditions under which the cloud-based services can be provided and consumed. The second step is the question, how will be these compliance requirements evaluated? According to the study (Simetinger,

2018c), in the case of cloud-based manufacturing, the compliance evaluation of the consumed services affects more the tasks on the consumer's side. There is a presumption that the impacts to the cloud provider are lower because they usually need specialized teams for ensuring security standards. At the same time, these teams must be also created on the consumer's side if the cloud services are incorporated into some process sensitive on norms and standards. The discussion in the study (Simetinger, 2018c) uncovered that even the specific SLAs are negotiated, during the audit, the final proof of compliance is on the consumer's side and it means that also the consumer must be able to monitor and assess the meeting of these SLA criteria.

In result, the vision and future of cloud-based manufacturing are based on hybrid environments with the combination of cloud services with own applications. But similarly as in the previous areas, there are issues and unanswered questions in the organization area. It includes the appropriate assessment of what kind of services brings the true benefits. It means benefits after the deduction of the additional costs for maintaining the compliance of the whole system.

Other issues are related to the idea of distributed dynamic supply chains. In the case of this scenario, it is expected a close integration between two or more subjects. The realization of a situation when one or more organizations can influence planning on the side of other participants is difficult. It is also much more related to relationship building and maintaining trust between organizations.

SOLUTIONS AND RECOMMENDATIONS

In the previous section, a lot of issues were outlined. In fact, quite complex and challenging issues are present in the Industry 4.0 world. In such situations, it is a good practice returning to the basics. So, business informatics is in the current world based on IT services. But how to describe an IT service? A relatively comprehensive definition of an IT service is: *IT services are coherent activities and/or information delivered by IT service provider to the IT service consumer. IT service is created by IT processes which consume IT resources (HW, SW, data, people). IT service is realized according to the agreed business and technical rules and conditions*. (Voříšek & Basl, 2008). At the first sight, this definition may look very generic, but it encapsulates the main and the most important topics.

The Service-Orientation in Industry 4.0

The knowledge gathered from the literature and the nature of solutions needs to be delivered in Industry 4.0 show the importance of modularization, flexibility, and adaptability. This goal can be achieved in many ways but the service-orientation concept with SOA in the front provides a well-elaborated approach and with currently mitigated risks as it was mentioned in the previous section.

As an important step during the move to the service-orientation concept or SOA is the definition of a proper and suitable approach to how to build services and manage them. Different standards and methodologies oriented on services or SOA have common traits. The authors (Simetinger & Zhang, 2020) of a recent article about Industry 4.0 traits are referencing a study (Simetinger, 2012) that performed a complex discussion of the SOA realization specifics and provided a summarization of available standards and methodologies. The author (Simetinger, 2012) summarizes the mutually beneficial concepts and integrates them into the more universal approach to the definition, creation, and managing of SOA services. There are combined organizational principles from methodologies ESA[21], ITIL v3[22], TOGAF[23],

and COBIT[24]. These principles are related to the IT service lifecycle in different perspectives and are summarized in a general overview called "Three Views Paradigm" and it is visible in Figure 2.

Figure 2. The Three Views Paradigm and the IT service lifecycle
Source: (Simetinger, 2012)

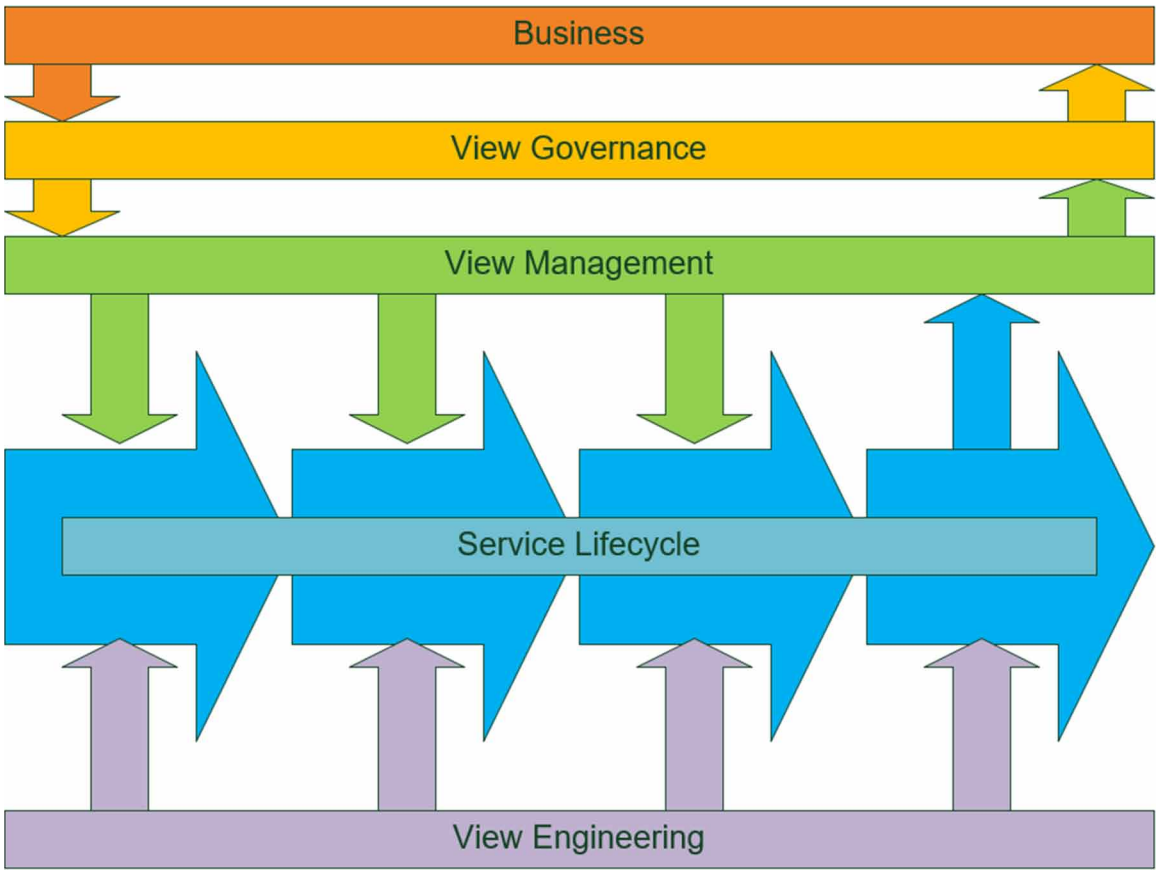


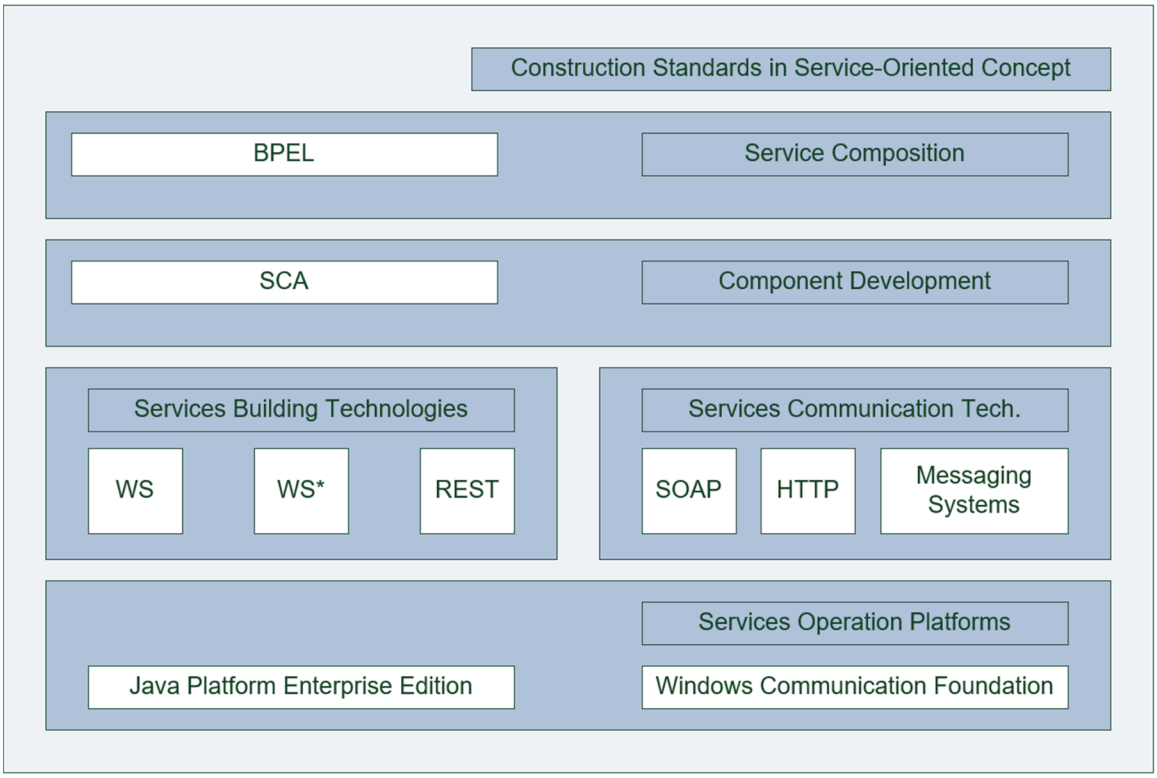
Figure 2 shows the main common trait of all combined methodologies - the lifecycle of the IT service which is part of a continual improvement process. This lifecycle is then affected by three different views:

- Engineering
- Management
- Governance

The View Engineering

The perspective Engineering solves the question of technical implementation and construction of SOA services. In Figure 3, there are summarized suitable standards and technologies which can be used in this area.

Figure 3. The standards and technologies which can be used for construction of the SOA services
Source: (Simetinger, 2012)



In Figure 3, there are three key elements: Service Composition, Component Development, and Services Communication Technology. Service Composition represents a process within the IT service. For this representation is used BPEL[25]. Service composition ensures the right business-IT alignment (Simetinger, 2012) because BPEL literally executes business processes which use different independent components within their steps.

SCA[26] is a portable concept which solves the development of highly standardized components. SCA can be perceived as the next step from SOA to the particular technical realization. As it is described in (Simetinger, 2012), SCA components combine the advantages of web services like interoperability and standardized interface, but without high-performance overheads when not necessary and with the possibility to use different communication channels (including messaging systems). These components are able to distinguish internal communication (for instance components in the same environment, server, instance, application, etc.) and external communication when all policies, rules, and security must be applied.

The communication between components and services is solved by Services Communication Technology. There are known standards commonly known in relation to web services: HTTP[27] and SOAP[28]. But these two options have some limitations in the shape of large performance overheads (Simetinger, 2012). The alternatives to these communication channels are messaging systems and products (for instance JMS, Tibco EMS, IBM MQ, etc.) which are more reliable, have better performance, and have higher variability in formats which they can reliably carry over (Simetinger, 2012).

It is possible to achieve modular architecture with a different combination of technologies and approaches. But the SCA with messaging systems and BPEL for orchestration represents a strong combination with many desired properties and proven feasibility. On the other hand, the view Engineering does not require experiments in the basic and middleware software. These technologies usually provide enough features and capabilities. The essential is to wisely choose the good combination of technologies which suits best to the development requirements.

The Views Management and Governance

The views Management and Governance are solving the alignment with the business strategy. This is realized via the definition of the IT strategy which includes rules, policies, and standards (on the Governance level) and their effective application to the operational activities and IT services (on the Management level). The influence between views and lifecycle of the IT service is outlined by arrows in Figure 2. The summarization of available standards for the service-oriented concept is available in (Simetinger, 2012) and the relationships between discussed standards are visible in Figure 4.

Figure 4. The standards in the service-oriented concept
Source: (Simetinger, 2012)

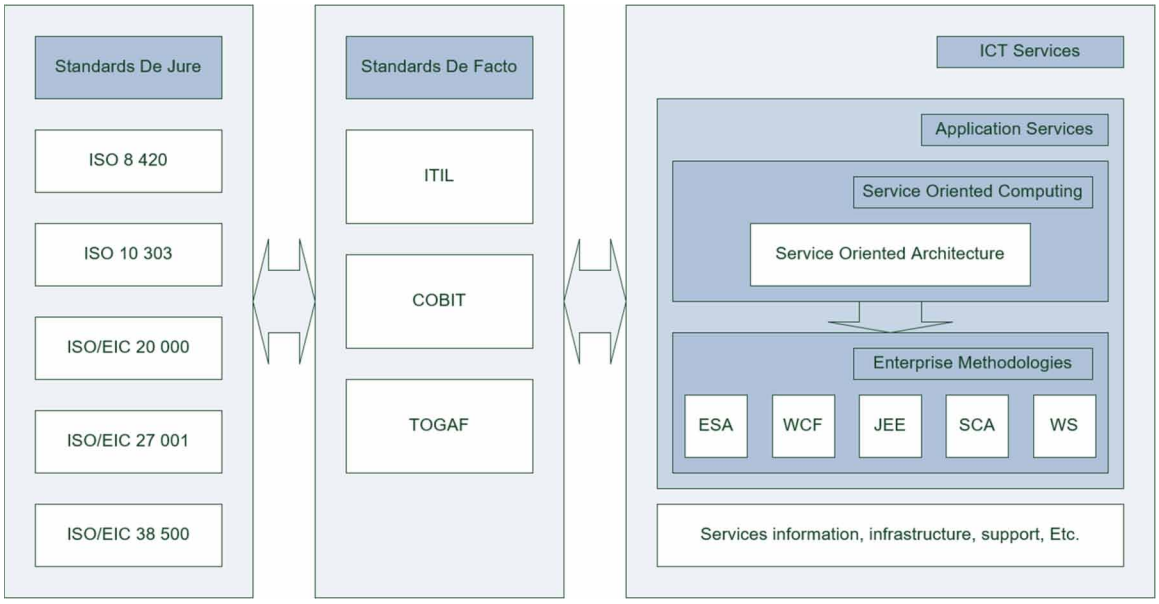


Figure 4 puts into context the "de jure" standards provided by the International Organization for Standardization (ISO) and the "de facto" standards issued by special interest and professional groups. These two types of standards are influencing each other. But in general, it is possible to say that the implementation of de facto standards makes the organization compliant with de jure standards. Using these standards leads to the definition of different services with own rules, principles, and policies, which can be composed within SOA services. The article (Simetinger, 2012) combines the principles and

rules for composable services from the de facto standards and provides the following types of services composed within SOA services:

- Process Service – is service which starts and manages the business process.
- Component Service – this service maintains context which is important for specific business function. Usually, it is a set of rules which are applied to operations of other services.
- Entity/Engine Service – is service which provides access to business objects or discrete parts of functionality like payment systems or other events triggered by service. The business object is a set of data and methods which can be reused in this case.
- Utility Service – is functionality which is shared across other services.

The article (Simetinger, 2012) also defines simple rules for these services:

- Using an internal canonical data model for communication inside integration infrastructure and between composed services.
- Standards like ODBC[29], JDBC[30], HTTP, WS[31], FTP[32], etc. should be used for communication with the external environment.
- For the construction of services is recommended standard SCA.
- Standards like WSDL[33] and UDDI[34] should be used for the description and management of services.

The study (Simetinger, 2012) adds an important comment related to the standards and rules which are inspired by the ESA framework. There are introduced three groups of standards: portability standards, semantic standards, and technology standards. Portability standards group defines standards which are used for accessing the basic functions in the infrastructure (like ODBC, FTP, oData[35], etc.). Technology standards group defines the boundaries for the view Engineering. The used technologies and approaches for the design and construction of the services and their components (like SCA, WS, etc.). A quite specific group are semantic standards. These standards define procedures for data transformation from data sources (for instance various database datatypes for commonly used value) into the common canonical model and from the canonical model to the form which is presented to users or consumers of the IT service. These standards also involve the principles and rules for handling of exceptions, their processing, and presentation to users. It makes these semantic standards a very important concept but often underestimated. Inconsistent treatment of these rules and procedures may lead to serious issues with compatibility, continuous integration of the SOA services, and user experience.

Views Management and Governance also involve handling of the continual improvement process. This process can be very individual and depends on a variety of factors. But it is possible to summarize the basic principles in this area. As it is described in (Simetinger, 2012), service lifecycle is managed by the view Management. It begins by the definition of requirements (including functionality, performance, quality, security). These defined requirements are a base for service modeling, development, deployment, and monitoring. Results from the monitoring are then reported to the view Governance. And as it was already discussed, the gathered requirements, defined policies, and rules are provided to the view Management by the view Governance. This is the purpose of the Three Views Paradigm from Figure 2. The view Governance acts as communication and translation layer between business and IT operations which ensures long-term strategic alignment.

It is important to be aware of the fact, that SOA in its pure form is standard and technology neutral. It is a set of principles not technologies. The spectrum of available protocols and technologies is indeed wider today. However, the principles, best practices, recommendations, and even technological examples summarized above are viable and robust enough to be used in today's development of solutions that meet the requirements of Industry 4.0 solutions. In fact, these summarized insights can still be considered as an optimal approach and as a role model for newer approaches that try to simplify this development. It is also a reason why SOA is in its own renaissance with all these older recommendations, which can be perceived as the answer to requirements of Industry 4.0, as is discussed in the literature research.

The Business-IT Alignment and Business Models

The Three Views Paradigm is a small piece focused on technical elements and their organization which a part of the larger picture. However, it is needed a broader approach for appropriate rearrangement of the relationship between business and IT.

The Importance of Business Models

Adding and incorporating modern financial methods in the economic management of IT is discussed in the previous sections. The gaps in this area are filled by using methods like BSC and EVA together with other common methods like ROI, ROE, and NPV. In combination with the perception of IT resources as assets the possibility to use the concept business models is opened. It fits into the concept of the strategizing process which results in a strategic plan with actions, business model, value chain and corresponding organizational structure (Wit & Meyer, 2014).

Business models are based on the following components: Key Partners, Key Activities, Key Resources, Value Proposition, Customer Relationships, Channels, Customer Segments, Cost Structure, and Revenue Streams (Osterwalder et al., 2010). In the context of IT services, the critical components are Key Activities, Key Resources, and Value Propositions (Simetinger, 2018a). The Value Proposition component is the subject with a value which is delivered to the customer/consumer with the agreed conditions like price, quality, quantity, brand, other products, etc. Key Activities are activities needed for delivering the Value Proposition component. It involves support, production, technological functions, and capabilities. Key Resources are assets needed for producing and delivering of the Value Proposition component. As assets are considered all possible resources: tangible, intangible, human resources, and financial resources (Osterwalder et al., 2010; Simetinger, 2018a; Wit & Meyer, 2014).

Using of EVA advanced financial method brings one important element and it is cash-flow. This method is partially based on cash-flow and together with other components which reflects the industry, expected or accepted risks, and other individually important circumstances, determines if the activity generates added value or devalues dedicated assets and resources. In the most basic form, the cash-flow is the difference between raw incomes and raw costs. In the real situation, it is needed to consider much more parameters, but for the representation of the concept and idea, this is sufficient. With the definition of unit costs and required EVA, it is possible to get the unit prices and profits. With unit costs and unit prices, it is possible to define indicator IT Service Cash-Flow (IT Service CF) in time. This cost/profit function is then part of the overall Business Model Cash-Flow (Business Model CF) cost/profit function. This model situation is in Figure 5.

Figure 5. The relationship between IT Service CF and Business Model CF
Source:(Simetinger, 2018a)

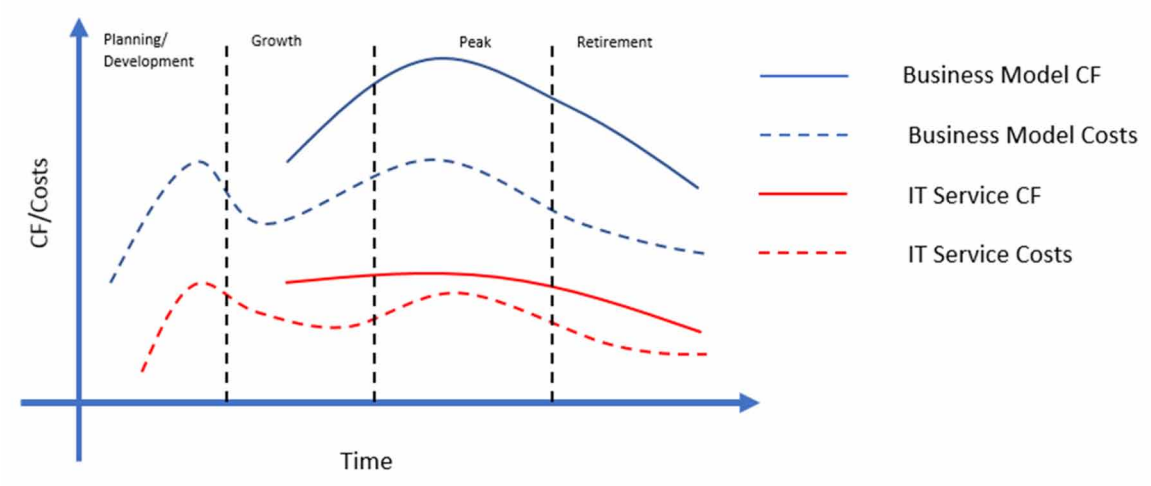


Figure 5 illustrates the relationship between the supported business model and involved IT service during the whole lifecycle of the business model. In this model example, IT Service CF represents payments received from business for using the IT service. Business Model CF is the cash-flow generated by this business model. It is also visible, how the costs are aligned during the phases of the life-cycle, especially in the planning and development phase. It is possible to say, that in this example, the IT service related costs are the dominant variable component in the total costs of the business model.

But the more important is the shift in the relationship between IT and business. IT acts here as a real partner of business in this model situation. They are both connected via payments for the IT service and both are equal participants of the business model. The risks are shared by both and the profits are also distributed according to the defined prices. At the same time, prices generated using EVA method also covers the required profits of IT for further development and innovation. It means that the more business model is profitable, the more resources for innovative activities will be available. At the same time, these additional resources are not gained randomly, but they are distributed as the fair provision which reflects the desired profitability. And this it the shift, when IT is not only the entity with high costs at the beginning of the business project, but a real partner with tangible stakes on the business model.

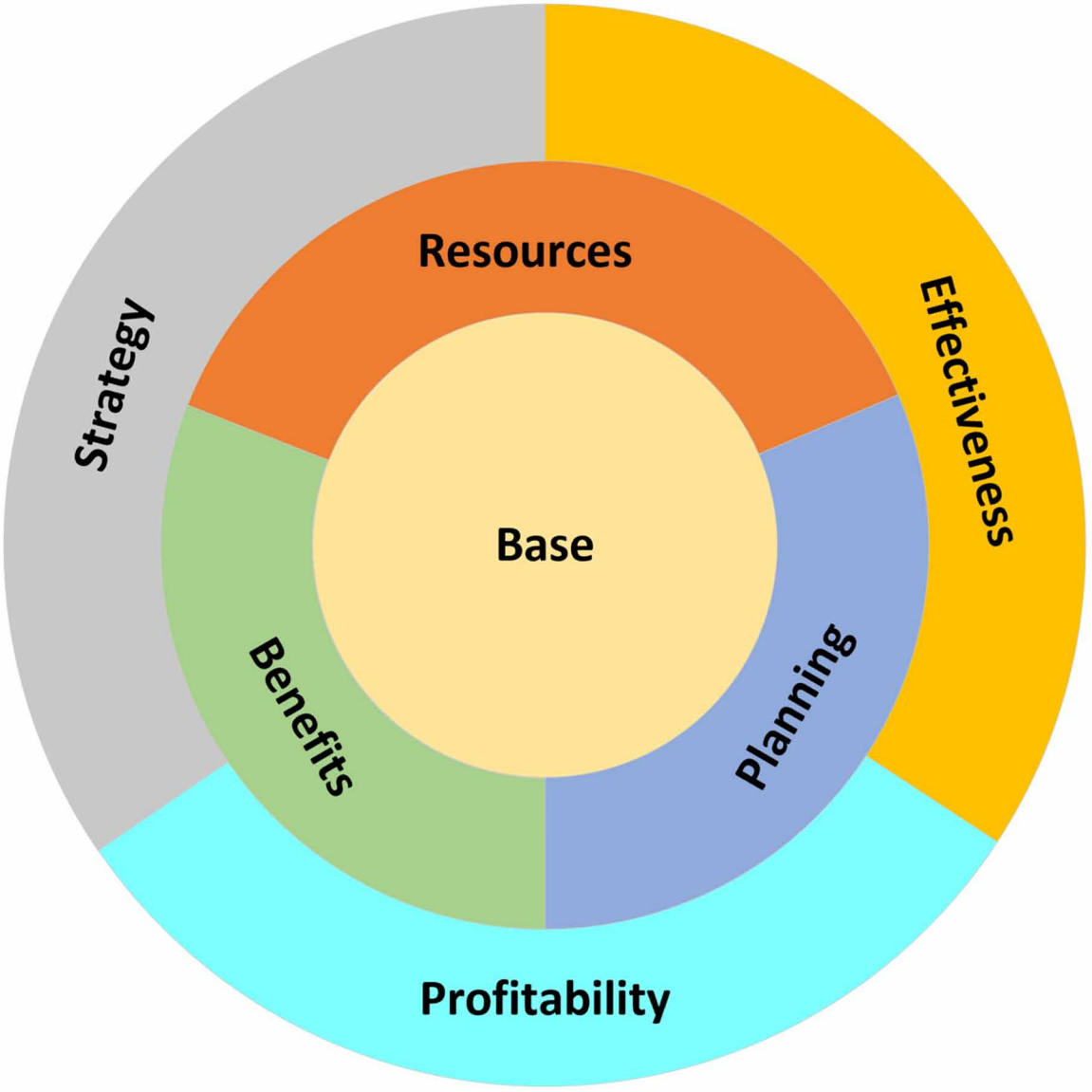
The Financial Management in IT

The motivation for the redesign of financial management in IT can be described by the following theorem: *But, at the same time, pressure on high profitability brings negative side effects. In the context of business models, the significant negative side effect is a reluctance to accepting long-term and resource demanding projects and investments. It is simpler to focus on short or mid-term targeted goals and investments without or with limited negative effects on the profitability*. (Wit & Meyer, 2014).

This theorem includes several issues described in the previous sections. On the other hand, the possible solutions are already outlined. As one of the possible solutions for financial management in IT can

be used a concept of Concentric Circles Method. This concept integrated the latest conclusions of the research in this area and it is shown in Figure 6.

Figure 6. The Concentric Circles Method
Source: (Simetinger, 2018b)



As is shown in Figure 6, this concept consists of three levels which are defined as follows (Simetinger, 2018b):

- The first level - it is called Base and on this level, it is expected the description of the actual situation of IT organization with the evidence of all available assets.

- The second level - this level includes more detailed information about the available resources and assets and the analysis of the suitability of the available resources and the actual operational demand for them.
- The third level - this level solves the relationship between business strategy and IT strategy in terms of the financial perspective of this relationship.

The financial management in IT requires the adaptation according to the internal rules of the organization. But in general understanding, it is possible to grasp these levels is as successive steps of economic management development.

The first level represents the real basics. Any organization which is not at the start of its activities need to formally cover some evidence of IT-related assets. It is not expected any strategic alignment, but growing from this level requires a simple form of CMDB[36] with a list of classified assets and related RACI[37] matrix.

The second level solves operational tasks in economic management. As it is mentioned in (Simetinger, 2018b), this level is focused on the operational efficiency and preparation for strategic planning. For the proper transition to this level, it is needed to solve questions of the benefits valuation, capacity planning, and resources allocation optimization. The main goal is the realization of such solutions which correspond to the business needs in a shorter time perspective. For this purpose, the methods ROI, ROE, or NPV are used.

The third level engages in a strategic perspective. On this level, the methods EVA and BSC are considered as appropriate methods for IT management. The publication (Simetinger, 2018b) highlights the main advantage of BSC, EVA, and cash-flow based methods with the effective support of "make or buy" decisions which result in the sourcing strategy. In other words, on this level, the main task is the evaluation of price feasibility in the process of procurement of assets and delivering of IT services.

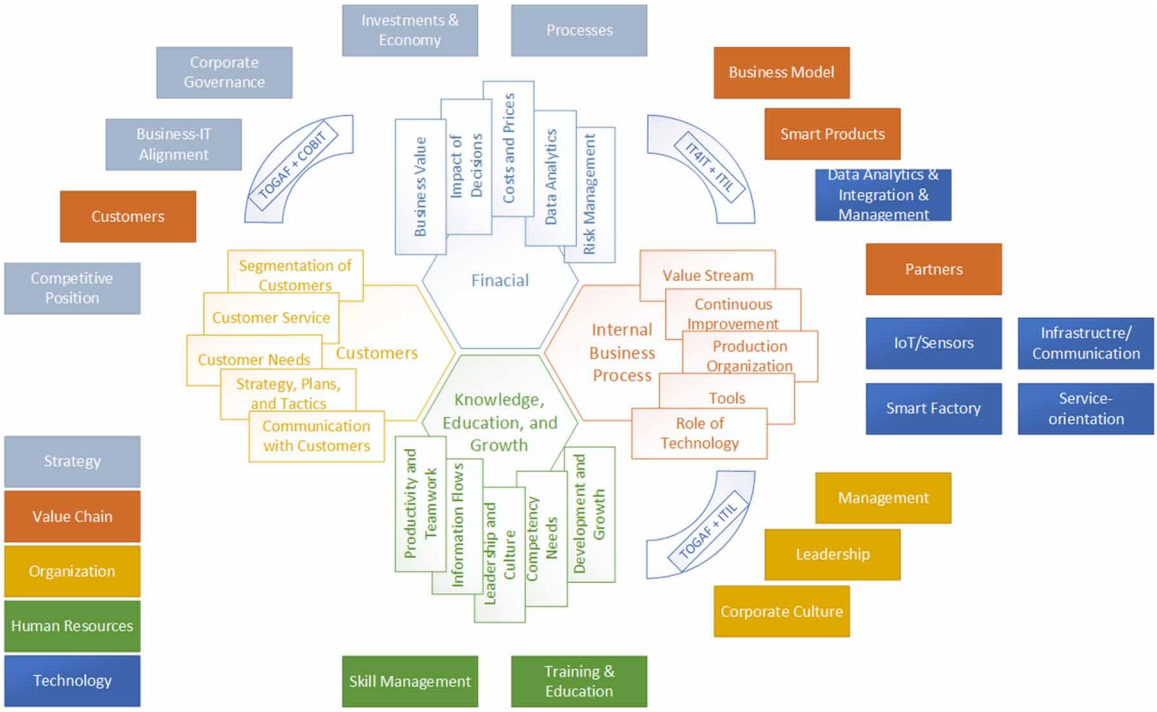
BSC and EVA based models are covering all three areas on the third level of the Concentric Circles Method and at the same time, the Concentric Circles Method is a vital source for the switch to BSC as a new core of global IT management model.

The BSC as the Future of IT organization

The main advantages of the BSC method are flexibility and adaptability. Despite the fact that this method is quite old, it is still popular and this popularity even growths. As it is mentioned in the previous sections, BSC is getting into new areas like, for instance, IT.

This method introduces four dimensions: Customers, Financial, Internal Business Process, and Knowledge, Education, and Growth (Hannabarger et al., 2007). It is not probably visible on the first sight, but these dimensions are corresponding to the clusters identified in the comparative analysis of Industry 4.0 maturity models. And, what is also beneficial, the BSC method can be combined with already mentioned IT-specific methodologies TOGAF, ITIL, COBIT, and relatively new methodology IT4IT which is focused on delivering value by IT. For better illustration, this concept is visible in Figure 7.

Figure 7. The adapted BSC method
Source: Author



These clusters are surrounding the original form of the BSC method according to the corresponding context within BSC. The IT-specific methodologies are placed as a possible enhancement between BSC dimensions. These methodologies are providing special tasks and activities suitable for IT which can replace tasks and activities in the original BSC method.

As examples of such replacements can be mentioned:

- Processes APO06 Manage Budget and BAI09 from COBIT 5 which elaborate the conception of unit costs in IT
- TOGAF framework has a complex framework for the definition of needed skills and competencies and their mapping to the IT services
- BSC methods can help with the cluster Competitive Position where the original methods from the BSC method can be used because IT-specific methodologies do not provide a comparable alternative

It results in an adapted BSC model which is prepared for use in IT but at the same time, it maintains an understandable form for the rest of the organization. It means that IT-specific processes and outputs can be presented and interpreted in the templates and outputs of the BSC method which are prepared for business from the beginning.

Modern Concepts of Management

The previous sections and the literature review are heading towards the essential prerequisite and it is the effectivity and efficiency of leadership and culture. The combined conclusions from the recent researches (Edmondson, 2019; Koller et al., 2018; Koller & Lovallo, 2018) are proposing methods and changes in the environment which may lead to the opening to innovations and changes and supporting of the creative culture. But what if the current environment can be compared to trench warfare? What is the possible solution for this stalemate which many organizations face?

These issues have origins in the lack of soft skills, beliefs, shared values, characters, and trust of the people (Covey, 2009). It is possible to reach progress via training and education. But people with low morale in a hostile environment often feel these activities as additional annoyances. The solution, in this case, is the implementation of real leadership with the ability to motivate these people. It can be done via building trust, rapport, openness, and elimination of the fear from exemplary punishments and other similar authoritative practices. In other words, the building of psychological safety (Edmondson, 2019).

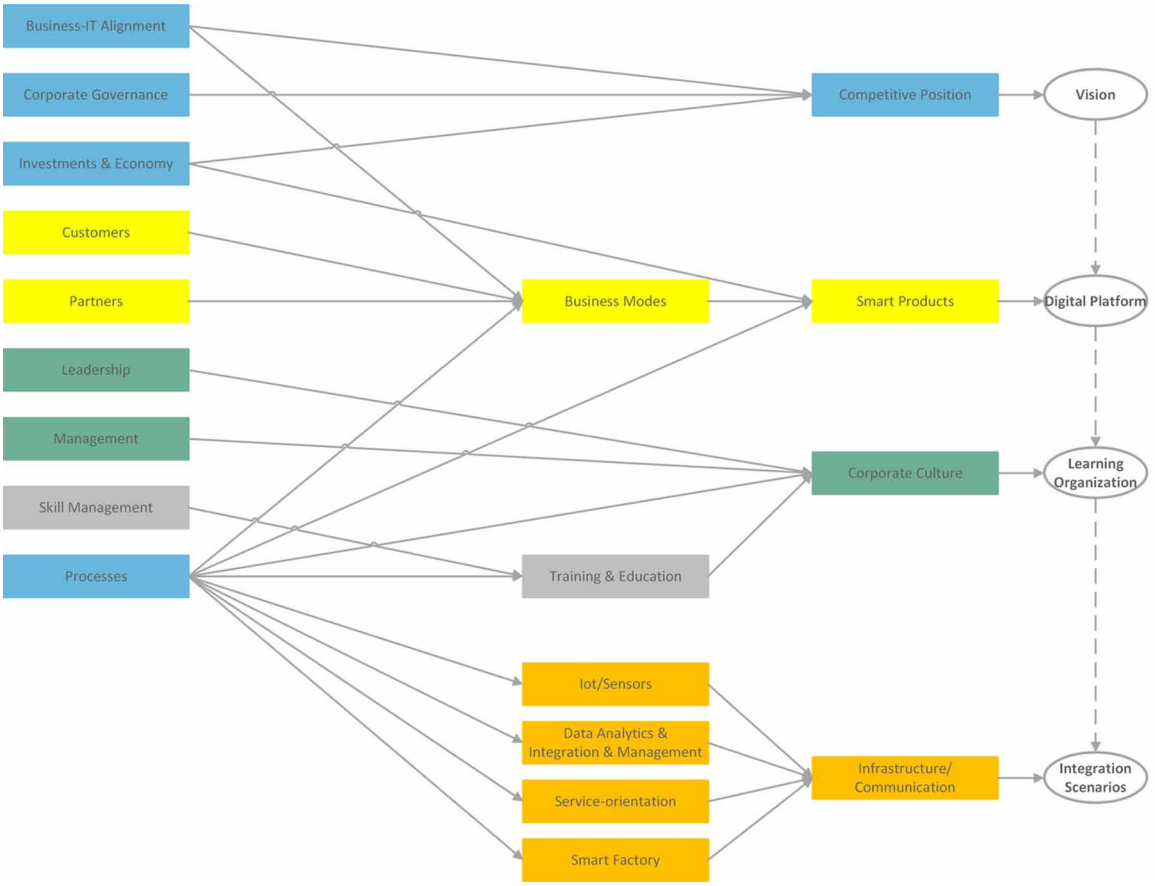
The success of such change is conditioned by bringing true leaders with the ability to motivate others. Such people have the ability to spread their values and principles among the others even if they are not motivated at the beginning. According to (Koller & Lovallo, 2018), the required penetration by these persons for the start of spreading is between 10% and 20%. These people can be perceived as vital transplants in diseased tissue which strengthen the organism and result in the restoration. So, the main question is how to get these people into the right positions. In the book (Chamorro-Premuzic, 2019), this topic is elaborated. It is not so important if these people are promoted within an internal organizational structure or hired from outside. The important is the process of the identification of the right persons. The book literally mentioned that it is critical to avoid assessment based on the external traits which may indicate the strong personality, but which can be related to the overconfidence. Rather it is beneficial to prepare complex interviews which can be assessed and compared with benchmarks. These interviews are providing results which can provide insight into true motivations, values and exceptional assessment of the candidate's personality. This book (Chamorro-Premuzic, 2019) also mentions that persons with less dominant traits can be more balanced and according to benchmark they can have more suitable prepositions for a leadership role. In some cases, when this initiative is combined with a leadership personal audit, it can lead to extensive reorganization and creation of a new leadership team in, at least, a part of the organization.

On one side, such transformation may be painful, and it probably takes time. It can take even years if the situation in the organization has serious problems. But especially in such situations, these steps are needed, because time passes anyway. The history and last discoveries in this area indicate, that organizations without appropriate culture which supports innovation, openness, and high added value for their customers must inevitably starve to death regardless their current market position, products, and services.

The Development of an Organization

The previously proposed solutions to issues were focused mainly on internal areas of an organization. But as it was mentioned, Industry 4.0 aims to better integration between more organizations. The identification of the structural dependencies between clusters also provided a development roadmap for improving of the organization's maturity from the perspective of Industry 4.0.

Figure 8. The development road map and key areas
Source: Author



The roadmap in Figure 8 illustrates mentioned dependencies between clusters and key areas that represent major steps in the development of an organization. These key areas are Vision, Digital Platform, Learning Organization, and Integration Scenarios.

The coupling of key areas is not strict. The first two areas Vision and Digital Platform have very close to each other and it is possible to say that they can be developed together. The opposite case is the key area Integration Scenarios. This key area needs inputs from the previous three to be possible to develop it properly. In other words, the development of the last key area needs a higher level of maturity of the organization.

The first step is the definition of vision and mission in the first key area Vision. This step is followed by answering the questions of how do we do our business and what is our value proposition to our customers in the second key area Digital Platform.

The next step is crucial as an organization is focusing on its own improvement. This step, when it is transforming into a learning organization is a large milestone. The concept of Learning Organization is introduced in (Senge, 2006). This concept describes a cultural transformation when an organization is driven by feedback, ongoing education, and continual improvement. An important role has also the engagement and motivation of employees. In this context, it is possible to state that the main goal of

Industry 4.0 is the creation of a digital learning organization. An organization that uses the latest technology for gathering relevant feedback, valuable insights and innovations from internal sources (like employees), and using these inputs for its own improvement.

The last key area represents the optimal realization of all these ideas. And it means internally within an organization, but also externally with partners, customers, and other parties. It described the usage and role of data within an organization but also formalizes the interactions with third parties.

This development through the key areas also affects its possibility to solve issues related to cloud-based manufacturing and dynamic supply chains. These dependencies between clusters and their relations to particular key areas determine the priorities of the organizational development.

As a demonstration of the whole concept, it is possible to use the cluster Processes. In Figure 8, it is visible that this cluster is involved as a dependency in many other clusters. Including technical and non-technical as well. Processes are important in the definition of creating value, collecting and handling innovations, learning, providing formalized inputs for SOA, data processing, and production plans. Respectively, it has to be an input for Business Models, Corporate Culture, Training & Education, and nearly all technical clusters.

Regarding these findings, it is possible to state, that Industry 4.0 is not a technical topic. The boundaries of this idea are not limited only to answering questions related to a decision about the right technology. Industry 4.0 is an interdisciplinary topic that drives organizational transformation in various areas. Technology is one of them, but it is not the first. It is important to keep in mind, that in relation to technology, much more important question is “How?” and not “Which?”.

FUTURE RESEARCH DIRECTIONS

The future research directions in Industry 4.0 can be divided into two main groups: technological and organizational. The technological group involves the researches of advanced technologies and cloud services which can be used in the Industry 4.0 concept and which are the subject of the research. The organizational group is focused on corporate culture and leadership.

In terms of advanced technologies, the most promising in the context of Industry 4.0 are artificial intelligence (AI), block-chain, and data analytics. AI is one of the prerequisites for enabling automated smart factories. The idea of an automated smart factory evokes unprecedented advantages. Such facilities should be able to react to changes in the environment and on-demand. But in complex production processes, the adaptation of a smart factory in real-time must be supported by some kind of AI. At the moment of change, several decisions must be made, a variety of possible consequences must be assessed, and all of this has to be done very quickly. The ability of reliable AI decision-making is a hot topic for many researchers around the world.

The second technology is block-chain. This new concept of distributed databases has many possible applications. One of the possible real implementations is the monitoring of goods and products in the supply chain. There are industries where the transporting conditions of cargo must be monitored and audited. Block-Chain technology provides a transparent means for this activity. The history, which is in the block-chain database continually maintained, is possible to interpret as an audit log. At the same time, using block-chain in enterprise systems is a task under intensive development.

The third technology is data analytics. Data analytics is an underlying technology for the effective application of AI. AI-based decision-making must be supported by powerful data analytics capabili-

ties. At the same time, simulations and predictive analyses can be augmented by AI which can propose additional actions which may not be obvious from the human perspective. AI and data analytics can be used separately, but the research of their combined benefits is an important area.

The area of cloud services is related to AI and data analytics as well. For the majority of organizations, the operating of sufficient infrastructure for using AI and data analytics can be cost-ineffective. It is the reason why these services are available in the cloud where these functions can use scalable infrastructure and provide needed information in a reasonable time and at affordable costs. The opened question is how to design these services as universally reusable endpoints for the enterprise systems.

The organizational group represents the research in the area of effective leadership implementation and corporate culture development. It includes topics like empowerment, self-managed organizations, people motivation, effective rewarding systems, education, and many others. All these topics are under intensive research. Their importance is recognized as essential in Industry 4.0 and for the seizing of new opportunities as well. New discoveries in the organizational group can be game changers in the identification of new ways how to use the most advanced technologies. But the effective implementation of new management and leadership concepts remains an open question.

CONCLUSION

This chapter had the goal to answer several key questions which remain in the Industry 4.0 concept unanswered or they are answered only partially. Different areas were discussed. From the technically oriented topics which were focused on the design and development of Industry 4.0 solutions, over the architectural concepts which help to grasp this challenging task of the realization Industry 4.0 solutions, topics related to economic management and management of people involved in these projects, to transformation to a learning organization.

Through the sections, it is possible to watch how the number of factors of Industry 4.0 is increasing. It is possible to identify that the technical challenges are not only the challenges which are present in Industry 4.0, but there are also organizational, management, and leadership challenges which will emerge earlier or later. Fortunately, the possible solutions and answers to raised questions were discussed. The maturity models for Industry 4.0 were mentioned and how far they can push the Industry 4.0. These maturity models do not offer direct answers or even blueprints for Industry 4.0 ready systems. But they are offering the right ways for those who do not know how to start.

At the beginning of this chapter, three main questions were stated. Regarding the influence and requirements of Industry 4.0 on an organization, its IT department, and management team, the answer to this question can be stated as multidisciplinarity. Industry 4.0 exceeds technical topics and involves also cultural changes. The management team needs to find new effective ways for managing innovations, motivation and engagement of employees, and support collaboration between various departments, especially the IT department that should act as a key resource or key partner and not as a cost center. Regarding opportunities, challenges, specifics, and issues of Industry 4.0, the answer to this question can be stated as sensitive. Industry 4.0 aims to amplify competitive advantages. At the same time, the risks with vague goals and requirements are amplified as well. The projects related to the realization of Industry 4.0 have to be with clear goals, sober budgets and expectations, and long-term horizons. On the other hand, well-managed Industry 4.0 projects have a large potential to bring better effectiveness, higher profitability, revolutionary products and services, and improved health of an organization.

Regarding the last question about the role of Industry 4.0 in manufacturing, the answer is disruption. Ambitions of this concept are high and expected possibilities on high levels of maturity can transform whole industries. At the same time, such changes will take time, and production processes will have to adapt and change dramatically.

In the end, this chapter did not have the ambition to provide all possible solutions for existing problems in Industry 4.0. The ambition was to show different perspectives to the Industry 4.0 concept with specific issues and mention that there are possible solutions to these issues. At the same time, the proposed solutions are not universal, but the chapter is showing that the solutions can be created. On the other hand, the role of IT will be important, and IT is often a source of dramatic changes in an organization. It is no reason why it cannot drive transformation related to Industry 4.0. In any case, it is needed to assess the conditions and circumstances of an organization where these solutions should be applied. If this information is handed over, then the purpose of this chapter was fulfilled.

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KEY TERMS AND DEFINITIONS

Business Model: An economical and organizational representation of the process which delivers an added value.

Business-IT Alignment: An optimal harmonization of activities and goals between business informatics and the rest of the organization.

Effective Leadership: A set of skills, methods, and intuition which lead to the continuous growth of trust and engagement within an organization.

Industry 4.0: A concept when technologies, organizational structure, and innovative culture are combined for the achievement of groundbreaking competitive advantages.

Innovative Culture: An environment where people intentionally and willingly contribute to an organization and its development and progress.

Learning Organization: An organization with developed effective processes and culture that support collection and handling innovations, development, engagement and motivation of employees, and proactive use feedback.

SOA: An architectural concept which is characterized by high flexibility and modularity with defined boundaries by standards and principles.

Strategizing Process: An activity which leads to the creation of long-term goals and plans on how to achieve them within known circumstances and limitations.

ENDNOTES

1 Cyber-physical systems = this is a concept where physical appliances are monitored and controlled by computer systems in an automated manner

2 Internet of things = this is a concept where various devices (for instance sensors, servos, switches, etc.) are connected via a network and can communicate and be controlled

3 Internet of services = this is a concept where IoT is enhanced by an additional abstract layer - devices connected as IoT are represented by reachable services they are offering

4 Big data = this is a concept where a large amount of data is used for the identification of internal relationships within them, following data and statistical analysis, and possible predictions

5 Enterprise resource planning = type of business information system focused on the overall management of resources (money, material, products, documents, etc.) in a company

6 Customer relationship management = type of business information system focused on the management of relationships and communication with customers

7 Machine to machine = set of standards and services suitable for automated communication between devices and/or information systems; usually, the realization of this communication is focused on efficiency in low-performance networks

8 Manufacturing execution system = type of information system that ensures functions similar to the CPS concepts in a manufacturing environment

9 Multi-agent system = distributed architecture concept based on multiple independent actors that are able to cooperate together and maintain independence at the same time

10 Modular production system = concept based on MAS modified for use in a manufacturing environment

[11] Service-oriented architecture = architectural approach based on independent services that are able to cooperate with a focus on management and governance over these services; in relation to Industry 4.0, it is often mentioned as a possible solution for the realization of other introduced concepts

[12] Return on investments = financial method used for calculation when an investment will return back according to the expected profits from it

[13] Return on equity = financial method used for calculation of incomes from the asset

[14] Net present value = financial method for calculation of the value of a future income after considering an interest rate

[15] Balanced scorecard = managerial method with defined perspectives for evaluation and planning of company performance and actions

[16] Economic value added = advanced financial method for calculation of profitability (company, asset, or investment) with consideration of entrepreneurial risks, interest rates, and other costs ; this method determines if a company creates any added value on top of its costs and risks

[17] Service level agreement = formal declaration of the expected quality (like performance, availability, etc.) of a provided service with defined costs/payments and eventual compensations for violation of these conditions

[18] Computer-aided design = type of software used for designing products and preparation of their production

[19] Product lifecycle management = type of information system that manages all stages and steps in a product's lifecycle including its design, production, related logistics, and eventually customer support

[20] General data protection regulation = regulation of the European Union on how software providers and vendors have to manipulate, store, and shred sensitive personal data in their software products and services

[21] Enterprise services architecture = specific implementation of SOA from SAP company

[22] Information technology infrastructure library = management framework for managing IT services from Axelos company in the 3rd version

[23] The Open Group architecture framework = framework for enterprise architecture from The Open Group organization

[24] Control objectives for information technologies = management framework for IT governance from Isaca organization

[25] Business process execution language

[26] Service component architecture

[27] Hypertext transfer protocol = basic communication protocol used for accessing web pages via the Internet, but also usable for reaching services and other resources within a computer network

[28] Simple object access protocol = or simply SOAP in higher versions, specialized protocol introduced as message-oriented and designed for communication with and between services in compliance with SOA principles

[29] Open database connectivity = operating system interface that enables access to a database

[30] Java database connectivity = interface available in Java that enables access to a database

[31] Web services = specialized standard designed for building services in compliance with SOA principles

[32] File transfer protocol = protocol used for transferring files via a computer network or the Internet

[33] Web services description language = special notation for the description of a service interface

[34] Universal description, discovery, and integration = service registration and management system that enables the search of services and their automated usage/integration according to their service description

[35] Open data protocol = alternative to SOAP that provides access to services and their functions in the form of data requesting commands

[36] Configuration Management Database = type of information system that manages all relevant information about IT resources

[37] Responsible, Accountable, Consulted, Informed = approach for the definition of relationships between persons or business roles and activities within an organization or project

Chapter 7
The Algorithm of Semantic Analysis in Disruptive Information Security Systems

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ABSTRACT

This chapter represents some of the main drawbacks of DLP systems implemented by businesses in international practice. The main structural shortcomings of these systems have been analyzed, and the factors correlating with them were revealed. An experimental setup has been formed to assess the impact of changes in these factors on the Type 1 and 2 errors in the operation of the systems. The authors also provide the results of the research with the use of algorithms, including the influence of the identified factors in the business systems of different directions to improve the economic security of the company.

INTRODUCTION

A formalized approach to business allows you to clearly structure organizational actions in the form of documentation, some of which involves the display of potential actions of the organization. On the basis of corporate data sets, it is possible to form a set of indicators, which are then converted into models for evaluating the effectiveness of various kinds, and are used as well as insider audit information.

To counter such information security threats many organizations are implementing DLP-systems that allow analyzing data sets of corporate communication. One of the analysis sections in such systems is semantic-syntactic data analysis.

In the analysis of previous studies of such systems (DLP Technology, 1998), (Hart et al., n.d.) there is a tendency – the implementation of such systems can be used as a means of protecting information

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and preventing its leakage, but the operation of such systems is imperfect, primarily because the work of the automated analyzer is formalized and can not include data analysis in the context, as a result of the operation of such a system there are errors of the first and second kind (namely, errors of the first kind - the missing of confidential information leakage, as well as the high probability of false positives – errors of the second kind).

Based on the above studies, it is obvious that the work of the semantic analyzer within the DLP-system needs some categorization and indexing of data added to it with its correction to the context, which would reduce the errors of false positives of the system, as well as the number of errors of the first kind.

MOTIVATION

In the analysis of previous studies of such systems (DLP Technology, 1998), (Hart et al., n.d.) there is a tendency – the implementation of systems can be used as a means of protecting information and preventing its leaks, but the work of such systems is imperfect, primarily because the work of the automated analyzer is formalized and can not include context data analysis, as a result there are errors of the first and second kind (namely, errors of the first kind - the omission of confidential information leakage, as well as a high probability of false positives – errors of the second kind) in the work of such systems.

Based on the above studies, it becomes obvious that the work of the semantic analyzer within the DLP-system needs additional categorization and indexing of data with their correction to the context, which would reduce the errors of false positives of the system, as well as the number of errors of the first kind. Thus, the reason that initiated this study is an attempt to adapt the work of the final technological products that have already found a commercial form to the specifics of the final organizations with an increase in the quality of processing of data sets.

The ultimate goal of the study can be formulated as an increase in the efficiency of the analysis of official correspondence of the organization in the evaluation of information security.

CONTRIBUTION

In the framework of this study, we propose an experimental study of the algorithm, with the following improvements:

· the possibility of correction of data indexing depending on its location in the text;
· the categorization of the studied data sets by structured dictionaries with a specific signature database

The formulation of the scientific hypothesis is as follows: suppose that a given frequency of occurrence of tokens from signature bases prepared by the organization will more qualitatively indicate a certain level of its information security depending on the categorization of signature bases and correction for its location in the text.

The problem, the solution of which is proposed to be obtained in the work, is defined as optimization, namely: the need to maximize the number of fragments found, that informatively for the researcher cross the perimeter of the given signature constraints while minimizing the errors of false positives.

Thus, new parameters are added that determine the quality of the "output" of the processed information, which allows the end user to quickly find, or skip less the areas of actual interest without the additional working time expenditures for "false" alarms (pieces of information that actually do not indicate anything).

OVERVIEW OF APPROACHES

The DLP-system is used when it is necessary to protect sensitive data from internal threats. And if information security specialists have sufficiently mastered and apply the tools of protection against external violators, the internal situation is completely different.

The use of DLP-system in the structure of information security implies that the information security specialist understands:

· how company employees can organize the leakage of confidential data;
· what information should be protected from the threat of disclosure.

Comprehensive knowledge will help the specialist to better understand the principles of DLP technology and configure leak protection correctly. If you analyze all the data within the information system of the organization, there is a problem of excessive load on IT-resources and personnel. DLP works mainly "in conjunction" with the responsible specialist, who not only "teaches" the system to work correctly, introduces new and removes irrelevant rules, but also monitors the current, blocked or suspicious events in the information system.

At the moment, DLP-systems are already based on the core, which is universal in the possibility of combining two main types of text analysis methods in it – a stastic and a linguistic method: Gerardus Blokdyk (Blokdyk, 2019), Hart, M., Manadhata, P., and Johnson, R. (Hart et al., n.d.), Pshehotskaya, E., Sokolova, T., Ryabov, S. (Pshehotskaya et al., 2014). Nikitinsky, N., Sokolova, T., Pshehotskaya (Nikitinsky et al., 2014), Dunn, J. C. (Davies & Bouldin, 1979; Dunn, 1973), Davies, D. L.; Bouldin, D. W.(Newman et al., 2009), Newman, D., Asuncion, A., Smyth, P., Welling, M. (Nelson et al., 2012), Nelson, C., Pottenger, W. M., Keiler, H., and Grinberg, N. (Opsahl et al., 2010), Opsahl, T., Agneessens, F., Skvoretz, J. (Wasserman & Faust, 1994), Wasserman, S., Faust, K. (Hanneman & Riddle, 2011), Hanneman, R. A., Riddle, M. (Moody & Douglas, 2003), Breiman, L., Friedman, J. H., Olshen (Breiman et al., 1984).

At the same time, the Russian market of DLP-systems is still at the stage of formation and those systems use mainly one of the groups of analysis methods.

Currently, the main vendors of these products are InfoWatch, Jet Infosystems, Zecurion, Symantec, Iteranet, etc.

The main complaints of users of these systems are:

· the limitations of the analysis
· poor control over the actions of users
· solution focus only on large companies
· high cost

THE PROS AND CONS OF EXISTING APPROACHES

Let us consider in more detail the specifics of the technologies used.

The technology of linguistic analysis includes:

· morphological analysis – search for all possible word forms of information that must be protected from leakage;
· semantic analysis – search for important (key) information in the content of the file, the impact of entries on the qualitative characteristics of the file, the evaluation of the context of use.

Linguistic analysis shows the high quality of work with a large amount of information.

The disadvantages of linguistic analysis include binding to a particular language, when you can not use the DLP-system with the "English" core for the analysis of Russian-language information flows and vice versa. Another drawback is the difficulty of clear categorization when using a probabilistic approach, which keeps the accuracy of the response within 95%, while the leakage of any amount of confidential information may be critical for the company.

Statistical methods of analysis demonstrate accuracy close to 100 percent.

The principle of operation of the statistical method: at the first stage, the document (text) is divided into fragments of an acceptable value (not symbol by symbol, but enough to ensure the accuracy of the response). The hash is removed from the fragments (in DLP-systems the term Digital Fingerprint occurs). The hash is then compared to the hash of the reference fragment taken from the document. When a match occurs, the system marks the document as confidential and acts in accordance with security policies.

The advantage of the solutions is that the effectiveness of statistical analysis does not depend on the language and the availability of non-text information in the document.

The disadvantage of the statistical method is that the algorithm is not able to learn independently, form and type categories. As a result – the dependence on the competence of the specialist and the probability of setting a hash of such size, when the analysis will give an excessive number of false positives. It is easy to eliminate the drawback if you follow the recommendations of the developer to configure the system.

Based on the main complaints of users of existing systems, as well as the disadvantages identified in the approaches used by the vendors, it is obvious that one of the key problems that require system improvements is the lack of ability to adapt systems to the specifics of organizations, and this problem will grow even worse under the influence of industry specifics as the market grows.

THE PROPOSED METHOD

The principle of operation of the method described in the work is that we take a standard statistical method, and add complimentary factors to it that affect the result; the information security department employee of the organization can correct the degree of influence of these factors at the moment when he believes that the current qualitative result of inspections began to diverge from previously obtained ones. Moreover, the algorithm of such correction of the parameters is also proposed in the work.

The method was tested on the following experimental data.

The study examined fragments of official correspondence relating to all violations, including confidentiality, over the past 3 months in organizations. Such a volume of data was chosen due to the fact

that the regularity of the research results on the formed databases began to manifest itself steadily on this volume. Consideration has been given to official correspondence in organizations with the following profile:

- information technology,
- legal service,
- banking activity.

The following sources of analyzed data sets were formed:

1. Corporate email
2. Social network
3. SMS
4. Messengers for correspondence within the company
5. History of queries on the Internet
6. Fax

Signature databases were collected as a result of expert semantic research. The collected data sources were processed by the time of "entering" the experiment:

In terms of the formation of signature bases on the following points:

· Filling of databases based on the submitted data
· "Weighing" of the words
· Stemming

In terms of the formation of the text array by the following point:

· Autocorrector (correction of grammatical errors).

ADVANTAGES IN COMPARISON WITH EXISTING SYSTEMS

According to the research results, it is obvious that the proposed methods of improving the efficiency of DLP-systems in terms of semantic analysis of service data sources significantly affect errors of the second kind. Probably, the improvement of the analysis quality is achieved, first of all, by the flexibility of signature databases (namely, the possibility of adding signature words specific to each type of organization in dictionaries, i.e. adaptability of the studied texts to the specifics of the work of organization along with the basic expert categorization), as well as by adjusting the shingle weights to the context, i.e., by distance of indicator words from each other.

The solution is quite lightweight due to the use of stemming, which eliminates the storage of logically (but not morphologically) duplicate data. In addition, this solution provides a logically built algorithm – a sequence of actions which the security officer will use if he needs to make changes, without the necessity to involve linguists to update dictionaries.

DISADVANTAGES OF DEVELOPMENT

The main problems in the derived algorithm are the following:

1. Only manual updating of dictionaries is implemented, which leads to prohibitively large time costs when adapting the product;
2. There are no ways to intercept the deliberately distorted information that is impossible to catch in the current method because of its character of a mismatch with its corresponding in meaning-based vocabulary;
3. The algorithm misses a module responsible for the detection of attempts to encrypt the data.

These shortcomings were discovered at the stage of testing the algorithm on production data, and work is already underway to expand the functionality of data processing to track the above problems.

EXPERIMENT

The purpose of the experiment – management and research, as a result of each new run we have an optimized list of data indicating certain violations monitored.

According to the degree of influence on the conditions of the study, the experiment refers to active studies on the initial runs (because we actively change the initial conditions to achieve optimal results) and passive studies on the final studies, when we observe the results obtained on a representative sample of the studied cases.

According to the degree of human participation, the experiment is conducted using automatic, automated and non-automated means of research.

The aim of the study is to test the validity of the previously stated hypothesis and on this basis to perform a broad and in-depth study of the topic of scientific research.

Research problems:

1. Filling and correction of signature databases;
2. Development of automated software and analytical complex for verification;
3. Study of the influence of simulated conditions on the level of information security of the organization;
4. Development of principles, methods and means of forecasting the level of information security in information-analytical systems of organizations.

VARIABLE PARAMETERS, MEASUREMENT METHOD AND MEANS

The list of variable parameters, which affect the result of the study if changed:

· the number of contexts to explore,
· the number of vocabulary words (expressed in the removal/addition of words by an expert due to the specifics of a particular organization),

· the weight of lexicalized words (only for the active part of the study, for the passive part of the study these parameters are not variable),
· the setting of the surrounding area,
· the lower threshold of the output.

As a method of measuring factors we chose a direct method of measurement for all factors, since the desired value is established directly from experience. An integral part of the experimental studies are the measuring instruments, i.e. a set of technical means that provide the necessary information for the experimenter.

The measuring instruments in the present work include a system, which is a PC with the developed software installed on it (hereinafter – the analyzer program). Installation is represented by a set of means: system unit, monitor, keyboard, mouse.

Software requirements:

1. Delphi 7 and higher;
2. The developer software.
3. Installed stemmer and lemmatizer to bring the context to the format of a set of basic word forms (third-party program blocks).

For the work of the analyzer program, it is necessary to install the signature databases formed in the active part of the study.

Also, for the study it is necessary to move the original contexts in .txt format to the appropriate folder of the analyzer program.

DEFINITION OF THE EXPERIMENT FORMAT

As part of the collection of sources for research, their grouping and formation of signature bases in the object under study, arrays of communications are considered, correlated with unscheduled actions taking place in the organization, as well as violations of various nature.

The formal model of the offender, whose actions analysis is the focus of the development, is an internal offender - the user (remote user) of the information system.

Brief description of the offender:

· knows at least one legal access name;
· has all the necessary attributes that provide access to IP resources / pieces of information (for example, a password);
· has authorized access to information stored and/or processed in the system;
· can have the names of registered users of the company's information system and conduct password reconnaissance of registered users;
· may have information about the topology of the LAN of the Company used for access (the communication part of the subnet), technical means of information processing and used communication protocols and their services;

· has the possibility of direct (physical) access to the fragments of the LAN and the hardware of the information system (except for remote users);
· may have knowledge and experience of working with the technical means of the system and their maintenance, in the field of programming and computer technology, design and operation of automated information systems.

Consider the order of implementation of experiments. There are two parts in the experimental study, they are the active part of the study, and the passive, further there is information on each of them.

ACTIVE PART OF THE STUDY

Step 1: For the purposes of context correction of the words from the signature database (or hereinafter referred to as dictionaries) have been weighted on the basis of the following assumptions (formula 1):

Weight of the word= (number of contexts where the use of the word referred to the desired result) / (number of contexts where the word was found during the analysis) *10 – formula (1);

Step 2: After the formation of signature databases, their stemming or reduction of words to the basic word form was carried out, which allows to reduce the number of errors of the second kind (omissions of information).
Step 3: After the initial formation of the dictionary formed by the group and formation of the weights corresponding to these "stop words", the study of the object began anew, the results were correlated with the expert evaluation obtained as a result of the human factor impact on the assessment.
Step 4: For each stop word, the percentage of "discrepancy" was determined, when the word in the automated experimental system indicated the presence in the context of alarming signs, but this was not confirmed by experts. The percentage was determined relative to the number of all contexts taken in the experiment.
Step 5: Then the word that gave the highest percentage of error was removed from the dictionary. A step of factor change is 1 word. After changing the data within one cycle of 5 steps (i.e., when removing 1 word), the experiment was repeated with respect to the same data with the changed dictionary, upon that:
Step 6: If the percentage of errors of the second kind was higher, we left the word, removing the next word in order, that gave a high percentage of error.
Step 7: If the percentage of errors of the second kind was lower in repeated studies, and the percentage of errors of the 1st kind was higher, the word reduced the weight to such a state that the percentage of errors of the 2nd and 1st kind was lower in the next studies.
Step 8: If the recurring study of the percentage of errors 2 and 1 kind immediately decreased, the word was excluded from the dictionary.

PASSIVE PART OF THE STUDY

After the active part, we proceed to the passive part of the study – run & analysis of data flows under the influence of the formed dictionaries.

The elements of the analyzer algorithm can be represented as follows:

Step 1: The working dataset is analysed, the surrounding environment = a is introduced;
Step 2: The text is searched for the first word that matches the word from the dictionary, and then the text fragment with the shingle is analyzed;
Step 3: Selected in the second step, a piece of text is assigned a certain weight in accordance with the weight specified in the dictionary, and if two or more words are found in the fragment, their weights are summed up, and the suspicious fragment with data on the "weight of suspicion" goes to the output;
Step 4: Within the found shingle the total weight is adjusted for the distance of words;
Step 5: After that the next fragment is analysed similar to Step 2, i.e. the next word that coincides with the dictionary is searched, a piece of text is fragmented and checked for weight (Step 3)
Step 6: As a result of the analysis of the whole text, the fragments with weights are ranked in descending order of weight and go to the output of the program, the fragments with the largest weight are displayed first, and it is possible to set a limit (parameter = b) limiting the output of fragments with a low weight (fragments with weight <=b are not displayed). When you set an empty parameter field, you can see all the matches in the text.

ELEMENTS OF THE RESULTING ALGORITHM

The elements of the analyzer algorithm can be represented as follows:

1) Working data array goes to the analysis, the surrounding environment = ***a*** is introduced;
2) The text is searched for the first word that matches the word from the dictionary, and then the text fragment with the shingle determined according to the following formula 1 is analyzed:

$$Shingle = \{Searchwor>d - awords | Searchword + awords\}, \quad (1)$$

and in all cases, when the search word(s) - **a** words < 0, the shingle is defined as (formula 2):

$$Shingle = \{0 | Searchword + awords\}, \quad (2)$$

3) Selected in paragraph 2 piece of text is assigned a certain weight in accordance with the weight specified in the dictionary, and, if the fragment there are 2 or more words found, their weights are summed up, a suspicious fragment with data on the "weight of suspicion" goes to the output;

4) 4) Within the framework of the found shingle, the total weight is adjusted for the distance of words between them based on a linear relationship, i.e. according to the formula 3:

$$Shingleweight = \sum_{allwordsfromtheshingle} wordweightintheshingle - \sum_{allwordsfromthesh7ingle} numberofwordsbetweentheindexwords \quad (3)$$

5) After that the next fragment is analysed similar to Step 2, i.e. the next word that coincides with the dictionary is searched, a piece of text is fragmented and checked for weight (Step 3)
6) As a result of the analysis of the whole text, the fragments with weights are ranked in descending order of weight and go to the output of the program, the fragments with the largest weight are displayed first, and it is possible to set a limit (parameter = b) limiting the output of fragments with a low weight (fragments with weight <=b are not displayed). When you set an empty parameter field, you can see all the matches in the text.
7) To reduce errors of the second kind, we also included in the algorithm the possibility of specifying signature bases by adding new indicative words with expert weight.

Table 1. Examples

Example of the developed software	Selection of words to form dictionaries in the analyzed data set
Source fragment:	
X: please send me the result from the Bank environment…	*X: please send me the result from the Bank environment…*
Y: 1 is the result	*Y: 1 is the result*
Y: Good afternoon, what can be cleaned from the C drive?	*Y: Good afternoon, what can be cleaned from the C drive?*
Z: everything can be cleaned	*Z: everything can be cleaned*
Y: Colleagues, did anyone change the password ...? since the current one given in the parameters of the route does not suitable (I can not log in to the LM with it)	*Y: Colleagues, did anyone change the password ...? since the current one given in the parameters of the route does not suitable (I can not log in to the LM with it)*
*Z: test123** can be used*	*Z: test123** can be used*
Y: thank you	*Y: thank you*
Z: Colleagues, need help - put a couple of files to the cloud	*Z: Colleagues, need help - put a couple of files to the cloud*
Z: Thanks, already done	*Z: Thanks, already done*
Y: Colleagues, the environment will be urgently restarted now (notification from the Bank)	*Y: Colleagues, the environment will be urgently restarted now (notification from the Bank)*
Z: test1518	*Z: test1518*
Z: password from test	*Z: password from test*
Y: Colleagues, can I delete something from the environment? There is no disk space	*Y: Colleagues, can I delete something from the environment? There is no disk space*
Z: probably you can delete it	*Z: probably you can delete it*

Table 2. Output Results

Text fragment with the surrounding environment	Weight
put a couple of files to the cloud Z: Thanks, done	8
Y: Colleagues, did anyone change the password	7
Z: test1518 Z: password from test Y: colleague	7
X: please send me the result from the Bank environment… Y: 1 is the result	5
delete something from the environment? no disk space Z: probably you can delete it	4
can be cleaned from the C drive Z: everything can be cleaned	4

RESULTS AND DISCUSSION

The result of the research was based on a comparison of the number of errors of the 1st and 2nd kind in each case of the study of the arrays of official correspondence for each of the three organizations.

In the end, the IT company there were recorded 19 cases of violations/leaks/negligence, which required the analysis of information sources within the organization; in the work of the bank the research was conducted on 27 cases, in the legal company – on 9 cases available for analysis.

The results were compared using standard semantic analysis without categorization by signature databases, as well as without the use of contextual weight and the dependence of this weight on the distance of words between themselves within the shingle, and using the above technologies, the results of the comparison were as follows: for the IT organization, the results of errors of the 1st kind were corrective to their elimination within the range from 0 to 5 errors (1 result of 19), which can be considered the result of average quality, since the elimination of errors was observed in a single of all the studied cases. Errors of the 2nd kind were eliminated in the range from 0 to 5 errors (2 results out of 19), which can be considered as a result of good quality, since a decrease in the number of errors was observed in almost each of the 19 cases.

For a banking organization, the results of errors of the 1st kind were corrective in their elimination in the range from 0 to 4 errors (1 result out of 27), which can be considered an average quality result, since the elimination of errors was observed in a few of all the studied cases. Errors of the 2nd kind were eliminated in the range from 0 to 10 errors (1 result out of 27), which can be considered as an excellent quality result, since a decrease in the number of errors was observed in almost every of the 27 cases.

For a legal organization, the results of type 1 errors turned out to be corrective in the range from 0 to 1 errors (4 results out of 9), which can be considered a poor quality result, since the use of technologies minimally reduced the probability of type 1 errors in the course of data analysis. Errors of the 2nd kind were eliminated in the range from 0 to 8 errors (1 result out of 9), which can be considered as an excellent quality result, since a decrease in the number of errors was observed in almost every of the 9 cases.

From the results it is obvious that the proposed methods of improving the efficiency of DLP-systems in terms of their semantic analysis of service data sources significantly affect the errors of the 2nd kind, at the same time slightly adjusting the analysis in the issue of committing errors of the 1st kind. Probably, the increase in the quality of analysis as a result of reducing the number of errors of the 2nd kind is achieved, first of all, by the flexibility of signature databases (namely, the possibility of adding signature words specific for each type of organization to the dictionaries, i.e. adaptability of the studied texts to the

specifics of the organization along with the basic expert categorization), as well as adjusting the shingle weights to the context, i.e. the distance of the indicator words from each other.

The hypothesis «suppose that a given frequency of occurrence of tokens from signature bases prepared by the organization will more qualitatively indicate a certain level of its information security depending on the categorization of signature bases and correction for its location in the text» is confirmed with respect to errors of the 2nd kind and is not confirmed with respect to errors of the 1st kind.

As part of further improvements of the algorithm, as previously mentioned, it is planned to implement modules that intercept encryption and intentional distortion of the text. Also, the development is already underway, that will further automate the updating of dictionaries by employees.

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Chapter 8
The Innovative Blockchain Technology in the Sharing Economy Subject Decision Making

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ABSTRACT

The relevance of research is defined by the increasing importance of information technology support of managerial decisions of the modern economy subjects, whose priorities are progressively shifting from property to consumption, in the context of society innovation-digital transformation. The research is aimed at proposing ways to introduce the breakthrough blockchain technology into the system of interactions between sharing economy agents and at assessing the effect arising from the perspective of the transition to a true market economy of equal subjects. Achieving the goal of the study required the solution of such tasks as the identification of economic entities' decision-making algorithm and analysis of the advantages of innovative blockchain technology compared to the information sharing economy platforms that are actively working today. The novelty of the author's approach consists in substantiating the advantages of blockchain technology in approaching the goal of creating a socially oriented system of cooperation between equal actors.

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INTRODUCTION

The effectiveness of sharing economy subjects' managerial decisions is especially important in the context of global instability, increased competition and innovation-digital transformations. Communication technologies used in the decision-making process, including the blockchain technology influence this effectiveness greatly. The development of digital networks and clusters in which efficiency increases as the number of users grows, in combination with the institutional environment, has the most important manifestations in creating new models of managerial decision-making by rapidly developing sharing economy (trust economy) subjects, which improve the organization of interaction of participants (Belk, 2014; Bardhi & Eckhardt, 2012). The purpose of the study is to propose real ways of introducing breakthrough blockchain technology into the system of interactions between sharing economy agents and assessing the effect arising from the perspective of the transition to true peer-2-peer relations. So the identification of joint consumption economic entities' managerial decision-making algorithm as well as of "bottlenecks" in terms of information technology support to the decision-making process; analysis of the advantages of innovative blockchain technology compared to the information sharing economy platforms that are actively working today (Airbnb, Uber, BlaBlaCar, various CarSharing services, etc.); substantiating the strategy for introducing breakthrough blockchain technology into the system of interactions between sharing economy agents are the main objectives of the chapter.

The advantages of innovative blockchain technology disclosed in the study and the strategy for its implementation in the decision-making process of the sharing economy actors will overcome a number of problems arising in the development of their mutually beneficial interaction and will allow to get closer to the goal of creating a socially oriented system of cooperation between equal actors.

Background

As a result of rapid growth in the second decade of the twenty-first century, the share of the sharing economy in national economies is characterized by a constant increase, which can lead, according to PwC estimates, to its rapid (by 2025) output to a level comparable to traditional sectors (PwC, 2016). In 2016, at least 275 sharing economy organizations existed in 9 countries of the European Union included in the PwC survey system (Sundararajan, 2016). At present, the growth of these organizations is occurring at an increasing rate, in 2019 and subsequent years this growth will certainly continue. The first release of IPO by agents of sharing economy is planned, in some countries their activities are regulated by the state. Sharing economy gradually penetrates in all areas of modern social and economic life.

The key characteristic of such a fast-growing sharing economy is the quality of the organization of the system of interaction of numerous unfamiliar people to capitalize unused property, on the one hand, and use (usually short-term) of this property, on the other. The mutually beneficial cooperation of the agents of the economic system is thus formed not on the basis of the traditional market principle of "buying and selling" of property and state regulation. It develops, first of all, on a horizontal plane, in the direction of creating a socially-oriented system of cooperation between equal subjects - genuine peer-2-peer social-market relations.

Sharing economy is associated with the development of various forms of exchange, rent, sale, barter and donation of various types of physical and intangible resources. The system of joint consumption develops in many sectors of the modern economy – housing, travel, transport, clothing, etc.

Sharing economy in one form or another (second-hand drains, rental housing, etc.) has existed for a long time, but it was technological progress that spurred its development and transformed it into a large sector of the modern world economy.

In the historical aspect, the first main driver of the development of the sharing economy, which allowed erasing borders and minimizing transaction costs, was certainly the Internet in the 1990s, when the opportunity to contact contractors, to search consumer services without using traditional media (ads, etc.) arose. Popularization of the Internet continues to increase the scale and depth of the sharing economy. Thus, according to the expert community, the number of active Internet users in 2018 exceeded 4 billion or 53 percent of the world's population (Kemp, 2017).

The next key driver of the development of the sharing economy in the beginning of the 21st century was the technology of smartphones of the 2010s (Wallenstein & Shelat, 2017). According to (Kemp, 2018) the expert community, the number of unique users of mobile devices is 5.1 billion (68% of the world's population), with more than half of the world's population in 2018. Smartphones become the most preferred way to access the Internet (52% of Internet traffic is done via smartphones). The appearance of a widespread access to smartphones and the ability to download various applications, including ones in the sphere of sharing economy, has made their use much more convenient, frequent and simple, since the smartphone is always at hand and users can share services in real time.

The developers of the concept of joint consumption R. Botsman and R. Rogers have shown that in modern conditions of global digitization, Internet platforms for the exchange of goods between people and organizations are emerging (Botsman & Rogers, 2010). Using the Internet fundamentally changes the system of mutual communication between subjects of the sharing economy, initiating the transition from large market places (such as Craygsclist or eBay) to small, specialized platforms, such as car sharing network (RelayRides, Zipcar) and a system for exchanging travel (Airbnb).

Social media, which were developed in the 00s of the 21st century gave the new life to existing sharing economy services. In general, over 42% of the Earth population are already users of social networks in one form or another (Kemp, 2018), and it has an increasing influence on sharing economy, making it as personalized as possible. After all, social networks make it possible to bring user experience, which greatly contributes to the development of services and the promotion of services.

With the spread of the Internet and social networks, the process of Internet surfing is accelerating, giving rise to new consumer trends. One of these trends in the face of universal concern over excessive consumption and the growing popularity of sustainable development projects is the emergence of new forms of social interaction aimed at preserving the biosphere and even contributing to the emergence of a new outlook in people (Botsman & Rogers, 2010). In 2010, TIME Magazine named co-consumption as one of ten ideas that will change the world (Walsh, 2011).

The Internet makes it easy to find a partner to share any item. According to estimates of active users of the portal peers.org, the sharing of passenger cars can lead to a decrease in CO_2 emissions in the United States by 27%. Bicycle has become the other important, increasingly popular shared vehicle.

With the development of information technology and the expansion of the number of "sharing" platforms (sites specializing in promoting various kinds of shared goods owned by the owner), more than three quarters (78%) of Western countries declare their readiness to participate in various transactions of the economy of trust (Archibugi, Filippetti, & Frenz, 2013).

It should be noted however that with the rapid growth and development of the sharing economy there are also problems associated with the estrangement from its true essence. In the future, sharing economy should radically transform not only the economic, but also the social order of modern society

and creation of a socially-oriented system of cooperation between equal subjects - genuine peer-2-peer social-market relations, relations of absolutely equal subjects with complete freedom decision making is the main mechanism for this changes.

The key principle of cooperation of agents of sharing economy, traditionally, is the implementation of various mechanisms aimed at providing socially motivated access to the free capacity of an underutilized resource. However, as often happens with economic relations, the emphasis in them shifts towards monetization and profit.

Users are forced to give UGC (user generated content) to Internet companies, owners of social networks in order to use their services. On the example of the Youtube service, it is clear that at first the participants did not earn money from their videos, but over time, content creators began to receive millions of views and the company began to share advertising revenues with channels. People began to realize that UGC has value and started earning independently on similar services where companies do not make deductions. The previously non-existent sharing-ads market was born when advertising works because community members trust each other (are subscribers or have common views on things).

This situation happens due to the fact that the integration of a huge number of different people using the same Internet platforms always requires a certain "add-in" and this "add-in" is an entrepreneur whose main goal is to make a profit. And participants in a particular economic relationship in the sphere of sharing economy are "bound" by the terms of the said entrepreneur, often paying for his services, or otherwise participating in the monetization of the relationship.

Thus, the more sharing economy relationships are imbued with subjectivism, the more the "human factor" is present in them, the farther they are from genuine peer-2-peer relationships. The more they are formalized, they allow decisions to be made on the basis of objective criteria, the closer they are to equal and free.

The breakthrough technologies help to achieve this objectivity, by finding their application in sharing economy more and more.

One of the technologies that change the usual sharing economy order was the technology of Internet of Things (IoT), which provided fundamentally new infrastructure opportunities for the development of services and platforms for the economy of participation. IoT unites everyone and everything with everyone, creating a global integrated network of household and electronic equipment.

The introduction of the concept of the Internet of Things will lead to a radical breakdown of existing markets, existing models of economic interaction. Already now, IoT, speaking as a technology platform for sharing economy projects, not only changes the structure and intensity of competition in a number of markets (for example, rental housing markets, car sales and car rentals, etc.), but also reorients economic development from market mechanisms to hybrid, and in the future – to collaborative forms of economic interactions on fundamentally different, non-market principles. People, cars, natural resources, consumer habits and many other aspects of economic and social life are combined by the IoT platform. Anyone can use Bigdata and IoT for analytics and creating a predictive algorithm that can significantly increase productivity and reduce the marginal cost of production, will allow you to distribute a product or service almost for free.

The concept of smart cities can also be considered as one of the drivers of sharing economy, since active urbanization necessitates a more rational use of resources (electricity, roads, etc.) of a city. In fact, city dwellers do not wait for problems to be solved by municipal services, but are actively involved in their solution through the organization of communities.

Peer-to-peer (P2P) networks, which are based on equality of all participants, have become another important technology that helps develop a true sharing economy. Often there are no dedicated servers in such a network, and each node (peer) is both a client and acts as a server. In addition to pure P2P networks, there are so-called hybrid networks in which there are servers used to coordinate the work, search or provide information about existing network machines and their status. Hybrid networks combine the speed of centralized networks and the reliability of decentralized, thanks to hybrid schemes with independent indexing servers that synchronize information with each other. One of the applications of the peer-to-peer technology is the exchange of any files, their editing, and the sharing of storage.

The main problem of such networks for the economy is the lack of permissions of copyright holders of files, which means that recording companies, photo authors, and other media owners have losses. Losses, however, mirror the savings of network members. At the same time, it is technically almost impossible to stop the distribution of the file in a decentralized network. However, litigation and regulatory restrictions will continue to restrain this segment, which is a consequence of the lack of clear regulation. After all, well-known sites position themselves as information services and do not provide services directly. It does not like either large companies (loss of profits), or the state (loss of taxes). Regulation lags behind new technological solutions, there are many legal obstacles that need to be overcome. And many of them are related to the fact that the laws were written before peering was even possible. On the other hand, some online gaming platforms and even software publishers use peering to download games and applications between users.

The technology of peer-to-peer networks is used in distributed computing, the power of which exceeds the capabilities of any existing supercomputers. Peering can also be used in certain streaming media data scenarios, as well as in the organization of anonymous networks – the so-called Darknet, which differs from other distributed peer-to-peer networks by anonymity, encryption, and the fact that connections are established between nodes that trust each other (the so-called Private peer-to-peer). Thus, we can talk about the existence of a new technological platform and a whole phenomenon, which, of course, is one of the (hidden) parts of the SE, which requires a separate study. According to experts (Gayard, 2018; Moore & Rid, 2016), Darknet is often used as a virtual platform for trading prohibited goods and carrying out illegal financial transactions, while developing the basic principles of sharing economy in the hidden space of the Internet along with public services.

Thus, modern breakthrough technologies are the main tool for creating genuine peer-2-peer relations in general and for objectifying and optimizing their elements. In the context of this article, we are talking, in particular, about the decision-making process of sharing economy participants.

Due to the considerable uncertainty of the term "to share", which determines the variability of business models of organizations in the sphere of sharing economics, a qualitative content analysis was needed of the definitions of this term contained in the most cited articles of the Web of Science database, as well as the morphological analysis of company websites. Based on the content and morphological analysis, the types of interaction of economic actors characteristic of the economy of trust were identified, which made it possible to form criteria for the selection of subjects for research, as well as to identify the key components of business models: the management model and the type of Internet platform; competitive advantage business approach; technology and method of transaction.

It follows from the basic tenets of the theory of decision-making, that the rationalization of the decision-making process by the subjects of the sharing economy requires information and analytical support, the necessary stages of which, differing in the content of the solved analytical tasks, are schematically presented in Table 1.

Table 1. The main stages of the analytical scheme of management decision making

Stages	Content
1	Choosing a goal and setting a decision task
2	Identification of alternatives to achieve the goal
3	Description of possible states of the external environment of action
4	Estimation of probabilities of occurrence of specific environmental conditions
5	Identifing of possible outcomes
6	Description and evaluation of the results of the implementation of alternatives in specific environmental conditions
7	Selection of criteria for assessing the compliance of the results of the actions with the objectives
8	Assessment of the compliance of the results of the action with the set goal
9	Evaluation of the expected effect of the action
10	Comparison of individual alternatives for the expected effects of the action of their implementation and the selection of the best
11	Decision-making

Decision-making processes in the modern economy are based on a fairly wide range of information and analytical support tools. At the same time, the practice of making managerial decisions by subjects of sharing economy allowed to outline the main features of such tasks: multidimensionality, the need to simultaneously take into account when choosing alternatives of several targets, the need to evaluate alternatives from a fairly wide range of criteria, difficulties (sometimes impossible in principle) to create conditions for implementing alternatives, factors criteria and goals in quantitative form. Among the circumstances that complicate decision-making is the presence of a sufficiently large number of decision makers (DM). These circumstances make it difficult to use management methods that have already become traditional (Hamari, Sjöklint, &Ukkonen, 2016).

Because of this, the author's instrumental base, developed on the methodological foundation of hierarchy analysis by T. Saaty, as a recognized method of supporting management decision making through the hierarchical composition of a task and multi-criteria rating of alternatives (Saaty & Kearns,1985), served as the main research tool. The advantages of the method in terms of decision-making by economic actors of trust are:

- the hierarchical structure of the method reflects the interrelationship of alternative solutions with the factors on which they depend, as well as with the criteria for rating them, which visualizes the participants' views on the situation of decision making;
- using of tools requires a focused collection and grouping of information that provides a decision-making process, and also allows you to assess the quality (accuracy and consistency) of data;
- as a result of modeling the decision-making situation, it is possible to more adequately assess the influence of one or another factor on the priorities of decisions by identifying the most significant factors;
    - using of the method makes it possible to identify the "boundaries" of the stability of the ratings and to determine the likely situations of change in the decision.

About 100 companies selected for research were analyzed from the perspective of assessing the intensity of the implantation process of information and analytical support tools (technologies) for the decision-making process into the management system of a business organization (product promotion, communication with customers and partners, monitoring customer loyalty).

SOLUTIONS AND RECOMMENDATIONS

Despite some differences in the organization of interaction of subjects of the sharing economy (in access to a resource, its ownership and nature (material / non-material)), the term "to share" is the foundation of the characteristics of the "sharing economy" system as an interaction between two or more actors owning a certain resource. The key principles of this interaction should be considered such principles as (Petrini, Freitas, & Silveira, 2017):

- providing access to free capacity under-used by direct owners of resources using not only traditional (market), but also innovative (creative) tools;
- support of the transactional system of resources between suppliers – the owners of the resource and its consumers to the intermediary ensuring their interaction – managed by the organization of the platform;
- social and environmental (increasing social and environmental stability as opposed to material and financial interest) the motivation of the transaction implementation process.

The current conditions for the spread of global digital networks and the transition to an information-mobile society, increasingly relying on digital technologies, radically change the competition paradigm for the information paradigm (knowledge paradigm), in the center of which is the information market as the most important factor in the variability (inconsistency) of social economic development. The development of an "online economy" gradually makes priority in the activities of business entities the scope of original (innovative) developments, not only increasing the amount of expenditures on technological innovations, but also multiplying the importance of "human qualities". Intellectual and innovative, information, technology potential and strategies for converting it into an increase in the productivity of labor / income of an organization are becoming key technologies for sustainable innovation development of the world economy.

The ongoing qualitative changes cannot but influence the modern system of the polystructural strategic management of the development of subjects of sharing economy, forming conceptually new approaches that substantiate its focus on incrementing the information and technological potential. The dominant among them is the resource approach (in the center of which are the mechanisms for supporting the sustainable competitive advantages of business organizations by appropriating innovative rent) that the competitiveness of economic agents at all levels of strategic management is largely determined by the quality of management practice / strategy information technology potential and investment in its development.

Typical solutions for the management functions of the sharing economy subjects are presented in Table 2.

Table 2. Typical solutions for the sharing economy subjects' management functions

Planning
1. What is the most important task / mission of the business? 2. What should be the goal? 3. What changes are taking place in the external environment and how are they reflected and can affect the organization in the future? 4. What strategy and tactics should you choose to achieve your goals?
Organization of activities
1. How should the organization work? Is it advisable to enlarge the blocks of work performed? 2. How to harmoniously coordinate the functioning of the blocks and avoid inconsistencies? 3. Should the structure of the organization be changed due to changes in the external environment?
Motivation
1. What are the needs of employees of the organization? 2. To what extent are these needs being met in the course of activities aimed at achieving the goals of the organization? 3. If job satisfaction and employee productivity have increased, then why did this happen? 4. What can be done to improve job satisfaction and employee productivity?
Control
1. How should work results be measured? 2. How often should the results be assessed? 3. How well have we succeeded in achieving our goals? 4. If we are not sufficiently advanced towards our goals, then why did this happen and what adjustments should we make?

Since sharing economy focuses on the joint consumption of resources, mutually beneficial cooperation of market participants on the basis of "trust", one of the basic decisions necessary for adoption is the choice of the counterparty of the economic relationship and the service provided.

The tools of information and analytical support used in such managerial decision-making processes are fairly simple, do not have a systemic nature, and do not allow an objectively optimal decision to be made.

In general, previously, participants were guided by "anonymous" reviews and overview descriptions of "interested" participants. Recently, a new opportunity has appeared.

It is known, that for property rental services, such as Airbnb, the key reference point for those who want to rent an apartment are the reviews of other participants about the accommodation, and for the owner – the description of future residents. And only with the integration of social networks with a profile link, it was possible to directly carry out communications and evaluation. In addition, Airbnb allows you to bind your Facebook profile to your service so that subscribers can follow the movements of participants, followed by impressions and reviews about their stay.

Similarly, there are services and organization of joint travel type BlablaCar. So, reviews of real users allow you to choose the most suitable companions, i.e. the service is adaptive, and incompatible people will not be in the same car or in the same apartment. Further development of such approaches to the choice of sharing property was called co-living.

The technology of integrating social networks with similar services allows you to improve the reputation and reliability of reviews, since behind each comment, ideally, you should have your own real person profile. However, to protect yourself from phishing without a guarantee of matching a real person with a profile here will fail and users will still have to make an independent decision whether to trust the recall or not.

Note that these reviews in any case remain subjective, disordered, unsystematic. There are no unified criteria for writing reviews, each user is guided only by his personal idea of how he should look.

We can observe the best situation with the assessment of counterparties in the field of "housing" in compare with other areas of sharing economy.

For example, in the taxi services, the driver's rating is not always public, and based on the travel reviews, routes are centrally distributed according to the selected fare. So driver selection and pre-selection are not available and are limited by the system itself. In this regard, there was a flurry of claims in discrimination, in unsafe forms of driving against Uber, which has already led to the formation of a system of preliminary tracking of driver profiles and anonymous rating (Sullivan, 2015).

Another big problem is that many reviews are fake, there is a problem of monetization of reviews on centralized services – an artificial increase in the number of implausible comments. The process is debugged and there is a mass of players who provide services for cheating reviews, votes, etc. The main verification methods on websites is to check the IP address and user account, but IP checking can be easily bypassed using a VPN, a user account can be a "bot", although account promotion can be automated. As a result, most services are filled with dishonest information.

In our opinion, the algorithm for assessing the reputation of sharing economy subjects, developed on the basis of an assessment method that combines the rigor of an algorithmic approach with elements of the subjective structuring of a decision task – the hierarchy analysis method developed by the American scientist T. Saaty and representing one of the most well-known methods of system analysis of problems of any nature, based on the performance of consecutive multi-criteria calculations and aimed to establish on the basis of their relationship between generalizing and private indicators (Saaty & Kearns, 1985).

The hierarchy analysis method is a systematic procedure for the hierarchical representation of the essential elements of a problem situation, the resolution of which is aimed at making the management decision by the subject of sharing economy. This procedure consists in the decomposition of a specific problem into more and more simple components (from the goal to the comparable solutions to the problem - alternatives) and further processing of the sequence of decision judgments by pairwise comparisons. As a result, the relative degree (intensity) of interaction of elements in the hierarchy can be expressed. These judgments are then expressed numerically. The hierarchy analysis method includes procedures for synthesizing multiple judgments, obtaining priority criteria and finding alternative solutions.

Thus, assessing the reputation of a participant in the sharing economy relationship and making a decision on choosing one or another counterparty (the service provided) is a step-by-step process of setting priorities. At the first stage, the most important elements of the problem are identified; at the second – the best way to verify the observations, test and evaluate the elements; the next step may be to develop a method of applying solutions and assessing its quality. The whole process is subject to verification and rethinking until there is confidence that the process has covered all the important characteristics necessary to present and solve the problem.

The hierarchy analysis method is based on the principles of: identity and decomposition, discrimination and comparative judgments, and the principle of synthesis.

The principle of identity and decomposition involves structuring problems in the form of a hierarchy or a network, which is the first step in the application of the method. The hierarchy is built from the top (goals), through intermediate levels (primary factors, subjects and criteria on which subsequent levels depend) to the lowest level (which is a list of alternatives).

The decomposition of the problem consists in dividing it into hierarchy levels so that the elements of the lower level of the hierarchy are comparable in pairs to the elements of the next level up to the top

of the hierarchy (the law of hierarchical continuity). Thus, subject to the law of hierarchical continuity, all elements of one level are identical to each of the elements of the next level.

The principle of discrimination and comparative judgments comes into effect after the hierarchical / network reproduction of the problem and provides for a pairwise comparison of the elements of the hierarchy. During the survey, the elements of the task are compared in pairs to their effect ("weight", or "intensity") on their common characteristic.

Traditionally the hierarchy analysis method is an expert method, i.e. the assessment of the selected criteria of the system is carried out by experts in a certain field. We have transformed this method taking into account the objectives of the study and the evaluating "expert" is in our case is each of the participants in the sharing economy relationship.

The implementation of the procedure of pairwise comparisons is based on a measuring scale of relative importance, the two key requirements for which are the limb and the coverage of as many gradations as possible. The scale that meets these requirements, used in the algorithm for assessing the reputation of participants in sharing economy relations, is given in Table 3.

Table 3. Relative importance scale for comparing hierarchy elements (Saaty& Kearns, 1985)

	Definition	**Explanation**
1	Objects are equally important	Both objects make the same contribution to achieving the goal
3	The first one is a little more important than the second (weak superiority)	There are some reasons to prefer the first object to the second, but they cannot be considered irrefutable.
5	The first one is much more important than the second (strong superiority)	There is strong evidence that the first object is more important.
7	The first one is clearly more important than the second.	There are compelling reasons to prefer the first one to the second
9	The first one is absolutely more important than the second.	The superiority of the first object is so obvious that it can not cause the slightest doubt
2, 4, 6, 8	Values prescribed by intermediate judgments	Values are used when choosing between two odd adjacent numbers is complicated
Numbers inverse to the above nym (1/3, 1/5,etc.)	If, when comparing with the first object, the second one gets one of the above ranks of importance, then the first one, when comparing with the second one, gets the opposite value	

The principle of synthesis is used to combine the results of hierarchical decomposition and comparative judgments to form a multi-criteria assessment of the reputation of a participant of the sharing economy relationship.

For this, a set of local priorities of the assessment procedure is sequentially formed from groups of matrices of pairwise comparisons; the relative value (probability) of each individual element is calculated through the "solution" of matrices having inversely symmetric properties, synthesized by multiplying local priorities and priorities of the evaluation criteria, as well as summing up the element in accordance with the criteria that this element affects the global (composite) priorities of the elements of the reputation assessment . The global priority of a particular element is then used to weigh the local priorities

of the elements that are compared to it as a criterion and located lower level. The procedure continues to the lowest level.

An important advantage of the hierarchy analysis method is its ability to measure the quality characteristics of the system. This is achieved with the help of more precise formulations of goals and research objectives than in standard assessment methods, which simplifies the procedure for checking and controlling the subsequent application of the analysis results. Moreover, the hierarchy analysis method can be used as a tool for measuring quality, including in the hierarchy assessment criteria, by means of which the actual quality of the system is compared with the desired one.

The implementation of the three principles of the hierarchy analysis method implies the implementation of the following stages of assessing the reputation of counterparties using this method (Fig. 1):

- the preparatory stage at which the goals and objectives of the evaluation are formulated, the selection of criteria and indicators for evaluation, as well as methods and techniques for its implementation are carried out. At the same stage, the collection and preliminary processing of analytical information is carried out;
- the main stage, which includes analysis of internal and external factors and conditions of the counterparty; calculation and analysis of private and general indicators of reputation; calculation of the integral indicator of assessing the reputation of the counterparty;
- the final stage – the stage of generalization of the results of the reputation assessment and the decision to choose / not to choose a counterparty (provided service).

One of the main tasks of the preparatory stage is the selection of criteria, which is that it is necessary to decide on the basis of which characteristics the assessment will be made, in other words, what exactly in the provided service need to be assessed. Criteria for assessing the reputation of the counterparty must meet the requirements of realism (attainability and consistency during the analyzed period), specificity (compliance with the content of the counterparty's activities), efficiency (determined by linking the assessment results with the actual performance indicators of the sharing economy entity that form its reputation) dynamism (criteria must evolve), reliability (ensuring consistency of the results) (Lazareva, & Karaycheva, 2016; Ougolnitsky, Anopchenko, Gorbaneva, Lazareva, &Murzin, 2018).

The hierarchical structure of goals, factors, criteria and alternatives for assessing the reputation of the subject / services of sharing economy is formed, taking into account all the above requirements and fully reflects, in our opinion, the chain of possible effects of internal and external elements of the system of agents functioning on sharing economy platform (Fig. 2).

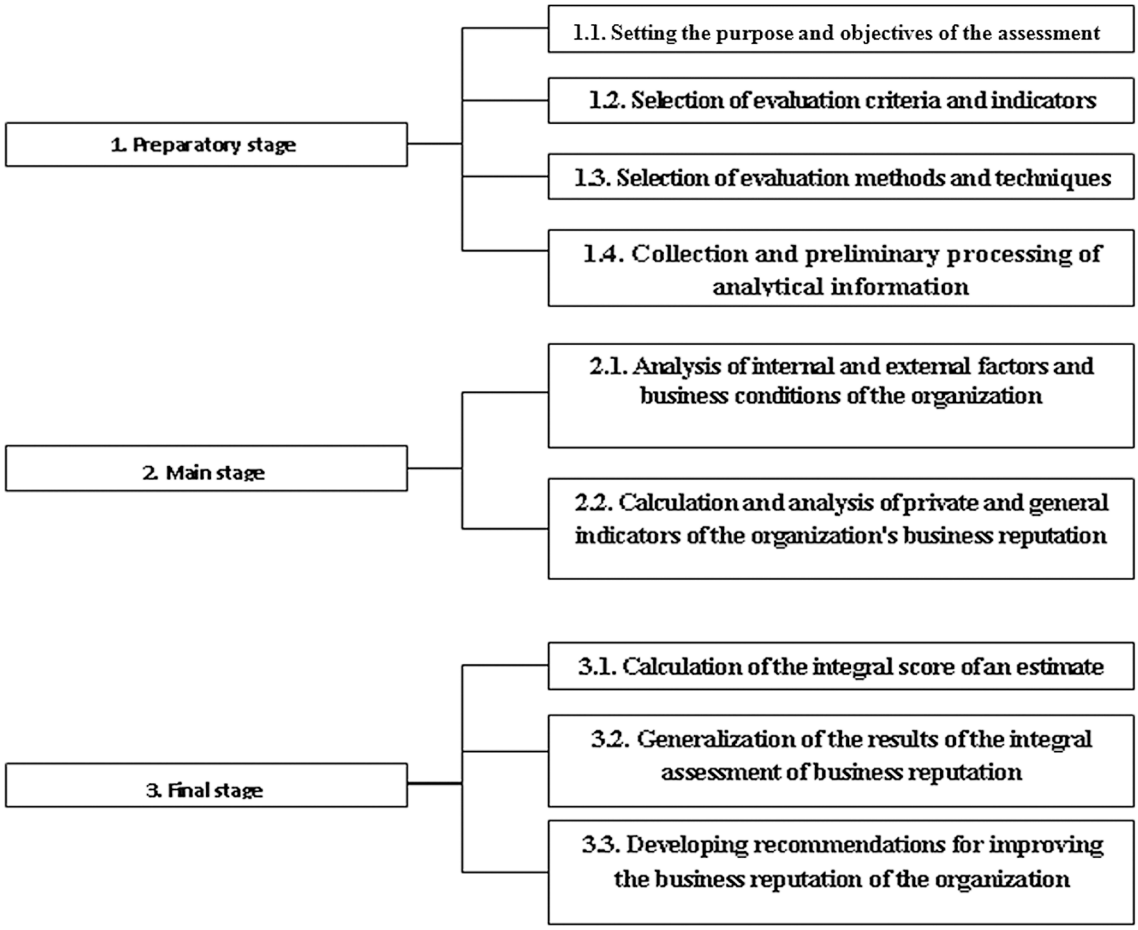
It should be noted that a specific system of criteria for assessing the subject / services of the sharing economy using hierarchy analysis method should be formed for each specific Internet platform (for example, for renting accommodation, searching for a driver, etc.) and due to significant differences in the essence of the service itself will differ to a large extent.

At the same time, in the most generalized form, this system looks as follows.

First of all, this system of criteria consists of external factors, which characterize the objective characteristics of the service, the external environment of its provision, etc. and internal, which depend directly on the person providing the service.

The group of external criteria for assessing the reputation of the sharing economy subject / service in the most generalized form includes:

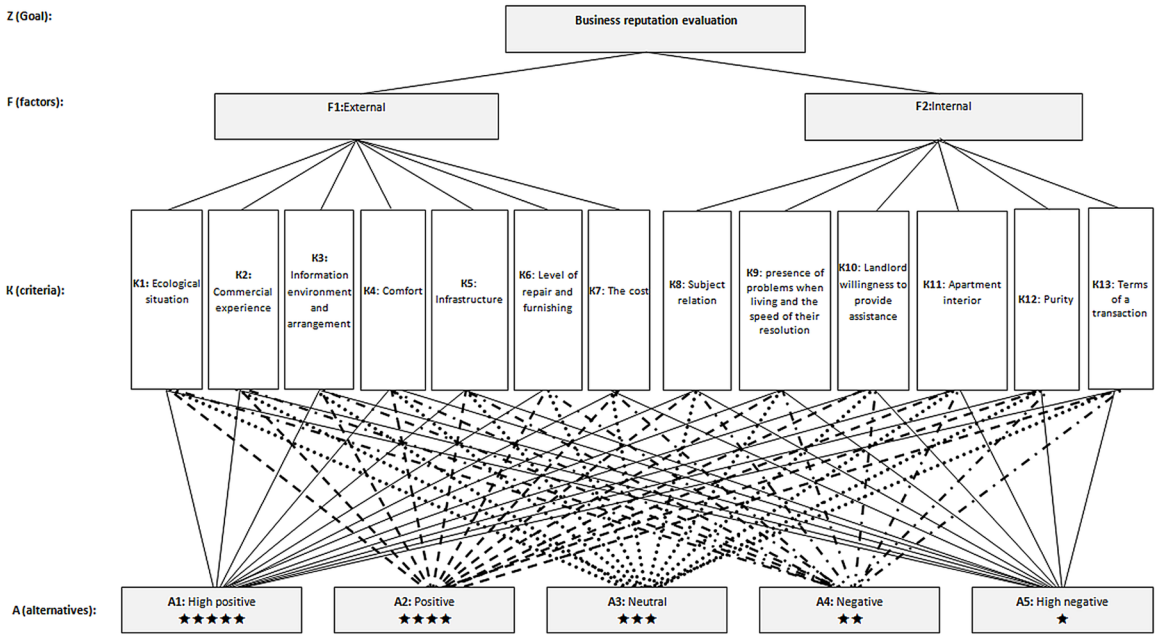
Figure 1. Counterparty reputation assessment algorithm in the sharing economy relationship system



1. Environmental quality of services - its compliance with generally accepted international regulatory, social and environmental requirements. For example, the degree of greening of the area of residence, the environmental class of a car engine, etc.
2. Experience in the provision of services, the duration of the existence on the sharing economy market, the presence (number) of repeated user visits to this service.
3. Information environment of the service provision - availability of information about it on the Internet - platforms, in applications, social networks.
4. The reputation of the service - the presence of different opinions, possibly preceding, about this service.
5. Convenience, external comfort. For example, the pedestrian availability of public transport or parking in the case of renting an apartment, the need to wait for the driver in the case of taxi services, etc.
6. The quality of the social infrastructure. For example, the availability of accessible proximity to shops, pharmacies, cafes, etc.
7. Quality and operability of equipment, including furniture, repair, etc.

8. Price of the service, including its dynamics.

Figure 2. Algorithm of the business reputation assessment



The following internal criteria for assessing the reputation of the sharing economy subject / service can be distinguished:

1. The skill level of the person providing the service.
2. Attitude of the person to the user of the service – politeness in communication, manner of conversation, type of behavior.
3. Reaction to the arisen problems, speed of their permission.
4. Quality of the service provided. For example, the internal comfort of the apartment (type and condition of the house, the area of the apartment and the number of rooms), car class, etc.
5. Clean
6. Terms of exchange, rent, sales, barter of resources (purity of the transaction). The dynamics of transactions.

In the practical implementation of our evaluation system, the fundamental issue to be resolved is the choice of information technology with which this evaluation system would be implemented in an optimal way.

In our opinion, the blockchain technology underlying cryptocurrencies fits in with the fundamental principles of the sharing economy organization and, as a result, can be used in many of its areas, change the way of life of billions of people and leave many everyday services and even entire state institutions on the sidelines.

There are opposing views on the innovative effect of the use of blockchain technology in the financial sector. In the sphere of sharing economy the issue of competitiveness of the blockchain technology remains virtually unexplored.

Nevertheless, it has become one of the answers to the desire of global corporations of the first wave of aggregation of the sharing economy sphere of total control and management, desire to transform them into monopoly power. For example, the largest taxi aggregators in China combined tariffs increased by 30-50% (Cendrowski, 2016); the booking.com service forces hoteliers to enter into exclusive contracts and overestimate tariffs for non-networked hotels; Uber, on the basis of machine learning systems, analyzes the activity of users in order to set the maximum acceptable tariff or dramatically increases the cost when the battery is very low (Newcomer, 2017; Chowdhry, 2016); Airbnb can block user accounts that do not correspond to its values (Menegus, 2017). Even governments may reduce administrative burdens on small and medium-sized enterprises thanks to blockchain technology to calculate value-added tax (VAT) (Sogaard, 2021).

All these manifestations in the sharing economy have become possible because of the presence of intermediaries. The trend of decentralization "1.0" is replaced by the decentralization of "2.0": users strive to protect their independence, increase the fairness of rewards and ratings. In this sense, the popularity of blockchain-based decentralization is correlated with the movement of anti-globalists, referendums to secede from various economic alliances. At the same time, "decentralization 2.0", based on smart blockchain contracts, will not lead to the destruction of centralized systems, but will help evolve existing peer-to-peer relations and reduce the users' dependence on intermediaries. We can pay attention to the services in the transport sector, which are more relevant to the values of Decentralization 2.0, for example, BlaBlaCar, in which prices are formed by the driver and passengers without the participation of the service.

The question of the competitiveness of this technology is not fully explored. For example, there are discussing questions about resolving the technical difficulties of using cryptocurrency technology or Blockchain 1.0. We list the main ones.

Bandwidth. The Bitcoin network processes only 1 transaction per second, with a maximum of 7 transactions. The increase in speed is possible in the case of increasing block sizes, which, in turn, will lead to an extensive increase in the size of the journal of records, which the developers are not yet ready to take. The Ehereum network processes up to 15 transactions in the absence of the possibility of its scaling, and the creator of the network V. Buterin himself admitted the difficulties in solving this problem (Pihl, 2019). As with the increase in the number of operations the network bandwidth inevitably falls, this leads to many hours of delays in conducting transactions and, ultimately, to the financial losses of customers.

Delays in processing and making payments are the second most important technical difficulty, which has not yet been resolved by the developer. At the same time, there are already a number of proposals and ideas on specialized forums to solve these difficulties, but they all need evaluation, stress testing, etc.

The reduction in network bandwidth with a consistently high user influx leads to an increase in transaction fees and sometimes the charges are unreasonably high. For example, over the past 2 years the cost could rise dozens of times in a short time (as of April 2019, the average commission for a Bitcoin transaction was $ 1.5, Ethereum was $ 0.14. But on December 22, 2017, Bitcoin reached $ 55.16, and according to Ethereum 2 jul 2018 - $ 5.53). The situation was aggravated by the fact that in the Ethereum network transactions are often sent between applications, which is the basis of smart contracts and for their users this is an increasing budget item. Thus, it seems necessary to focus on benefits other

than cash, which would allow the development of blockchain networks and this would not lead to high transaction costs.

Irrational consumption of electricity for mining may well compete with previous drawbacks, but on a global scale. Earth resources are limited, and one of the values of sharing economy is a careful attitude to resources. In this sense, we find a serious contradiction with the mining-cryptocurrency paradigm. Only calculations for Bitcoin make up 111.7 TWh / year or a quarter of a percent of global electricity consumption (overall), which is equivalent to 50% percent of the total amount of electricity consumed by datacenters worldwide (Vries, 2019a; Cambridge Center of Alternative Finance). At the same time, there are estimates that the majority of farms located in China, Sichuan, receive electricity from renewable sources (Kelly-Pitou, 2018), but they are volatile in nature, and the consumption of electricity by cryptocurrency only increases steadily. However, this is more concerned with algorithms based on the principle of Proof-of-Work (which Bitcoin, Litecoin, Dogecoin etc. works on), and other less energy-intensive algorithms such as Proof-of-Stake, Proof-of-Importance, Delegated-Byzantine-Fault-Tolerance, etc. One of the Ethereum based on them consumes significantly less energy (Vries, 2019b).

There are also risks in hidden bugs of the software implementation of the algorithms, compatibility of protocols and versions, and the unreliability of cryptobirth and curvature-based systems (breaking MtGox in 2014 with the theft of 650k Bitcoin and the subsequent crash of the stock exchange, breaking The Daoin 2016 with theft of 3600kEth and the subsequent forced hard fork of the Herium, the failure of the Parity system for managing the wallets of Eth in 2017 led to the loss of over $ 150 million by users). At the same time, there are a lot of cases of hacking and embezzlement in traditional banking institutions and corporations.

Having discussed all the main growth zones and directions for the development of the blockchain technology, we now dwell on the main advantages of this technology on the example of storing and calculating information about business reputation.

The blockchain stores information decentralized, and therefore it is extremely difficult to crack it - this solves the problem of the reliability of the stored data. In particular, the blockchain will reliably preserve the ratings, assessments and level of business reputation of the company, if it is used for its organization and storage.

The blockchain removes intermediaries. As a result, the possibility of data manipulation decreases. We have previously cited a number of examples where intermediaries act as a deterrent to sharing economy, overestimate transaction costs, carry out manipulative policies, etc. Using objective behaviors we will be able to arrive at a decentralized analogue of Airbnb 2.0 based on a distributed application in the blockchain, the user of which will be all property owners in rent. So, in case of need to rent a house, the user will turn to the database on the blockchain, search for and find a suitable option based on the preferences and reputation of the owners. At the same time, the blockchain will help with the assessment, calculation and management of the business reputation of homeowners. But this will not be limited to this, but will also form an agreement, select a tariff, pay for it through digital channels built into the system, etc. The system can operate on the basis of smart contracts, without a single center and with minimal commissions. The calculation of metrics is automated by their use — there is no subjectivity in the approaches, and all algorithms are public.

What is written in the blockchain is impossible to change. The preconditions for falsifying ratings and ratings, “rewriting history” disappear. Large monopolies or state structures may be interested in this, but the new level of freedom that sharing economy society will take will not allow them to do this.

The blockchain is open to everyone. Anyone who wants can check the recorded data and verify the level of business reputation. It is possible to develop open source software and everyone will be able to build a machine learning system based on open blockchain data, analyze, generate reports for any period. No need to request data from corporations.

Another disadvantage of blockchain is that privacy information of involved parties may leak due to blockchains openness to the public. However, some authors offer solutions, such as Privacy Respecting

Contract (Lei Xu., 2017), which integrates cryptography tools and blockchain technology and achieves the goal of supporting main features that public blockchain offered to international sharing economy applications without ruining user's privacy. It seems that more and more successful efforts of blockchain community should lead to increased trust among agents interacting in the blockchain, wishing to maintain anonymity. It was suggested another mechanisms to prevent disclosure (Christidis, 2016) using secure protocols like Encrypted Mesh Protocol TeleHash or directly using a content-addressed P2P file system. But these mechanisms are not a panacea, because of de-anonymisation approaches, undertaken by the hacker community (Casinoa, 2019).

Blockchain can be divided into several versions. If Blockchain 1.0 is designed to decentralize cash payments, Blockchain 2.0.is for decentralization of markets in a broader aspect, supporting transfers via the blockchain of many other types of assets. If you compare Blockchain 1.0.with the TCP / IP protocol stack, then the HTTP counterpart that is encapsulated inside it will be Blockchain 2.0.

The progressive development of blockchain can become one of the possible ways to artificial intelligence, and given freedom, the new organizing activities paradigm, more effectively and on a large scale, becomes more apparent in Blockchain 3.0 (Higgins, 2014) This will make it possible to implement solutions that are not related to market transactions, such as resolving disputes, organizing the work of the government, maintaining notary services and digital identity identification.

Having justified the choice of information technology blockchain for the implementation of the developed methodology for assessing the reputation of subjects / services of sharing economy, we present an algorithm for the implementation of this assessment.

First of all, we see the blockchain as the basis for an effective solution to the above described problem of fake reviews.

The reputation ratio of each participant of sharing economy relations changes in the process of transactions, contracts, and communication. Reputation is made up of reviews and ratings by tenants, as well as a backward assessment of landlords on the basis of their stay. The higher the reputation, the greater the chance to succeed is.

The blockchain reputation system stores information about users who have committed certain transactions in it using smart contracts. Each of the chain participants sees the history of the relationship of their counterparty in the form of a calculated reputation based on the feedback forms left. Also, each user has a unique identifier: so one tenant will not be able to create multiple accounts in order to increase the reputation of real estate objects from them.

Questionnaires are checked using the algorithm for calculating the level of reputation and smart contracts. To receive a review award, among other things, it is necessary to undergo account validation by the KYC (know your customer) procedure, which also excludes some of the potential dishonest users. The entire history, including the refutation of negative comments, is stored in the blockchain without the possibility of changing or deleting the comment left.

After the client connects to the network, it becomes possible to use FBK (FeedBacK coin) tokens – the proposed coins for conducting calculations when assessing the reputation of ecosystem users.

Exchange for fiat money is not expected. Calculating reputation for the services provided is carried out using smart contracts that record all transactions in the blockchain. Thus, it is impossible to get bonuses or improve the reputation of your business by cheating – you need to carry out real transactions. After the operation, the partners can leave feedback and evaluate each other's usefulness. As a result, there is an ecosystem in which completely different tenants and landlords will be involved, but the single token will be FBK, supported by the real economy.

As an example, consider a possible assessment of the reputation of contractors / services in the Airbnb short-term rental housing service – one of the most rapidly developing invested ($ 112 million from Andreessen Horowitz investment funds, DST Global and General Catalyst) sharing economy directions that were first internationally recognized (in 2012 through the site was booked for approximately 12-15 million overnight stays in more than 33,000 cities in 192 countries).

So, the main sharing economy service provided on this site is a short-term rental housing from its owner. Thus, the main decision that must be taken by a person who decides to use the service of this Internet platform is the choice of the counterparty, i.e. persons who will be rented housing.

The decision on this issue in the concept developed by us should be based on the integrated indicator of the business reputation of the specified entity, determined according to the following algorithm.

There is a central counterparty – Airbnb aggregator. It collects information about all users of its ecosystem and provides an information service for the selection of accommodation options, and also conducts an initial verification of landlords. Step by step the work of the mechanism can be represented as follows:

1. Owners, who want to rent housing, pre-add information about themselves in the database of the aggregator, linking their social network profile. During registration, the new landlord also sends all documentation and explanations about the property to the aggregator, including copies of passports, certificates, photos, assessment reports, etc. This data is encrypted and stored in a secure repository. It also receives the primary volume of tokens, equivalent to its number fund.
2. People who want to use the service of house renting, pre-add information about themselves in the database of the aggregator, linking their social network profile and going through the KYC (know your client) procedure. This data is encrypted and stored in a secure repository.
3. Users search for accommodation options using various filters as well as available reviews. For new accommodation options that have not yet had time to evaluate users apply the initial assessment of the aggregator and confirmed photos.
4. According to the results of residence, a smart contract is created, which is a segment of code that has two types of functions: changing state and not changing, and their launch is carried out by sending a broadcast to the address of the contract. The tenant is invited to rate the accommodation by filling out a questionnaire containing the main categories of questions by group: pre-communication, atmosphere / infrastructure, experience of living, experience of calculations, etc. The program code of the contract includes the implementation of the hierarchy analysis method, which calculates the reputation based on the recall. The encrypted document is stored in the contract and sent to the public network Ethereum. The tenant's interest is that the smart contract charges FBK tokens for providing information about living conditions.
5. A tenant who receives a request for accommodation from a specific user may also create a smart contract that sends a message to other users and landlords. These people may have previously interacted with this user and, most importantly, may be willing to give feedback about it. The advi-

sor writes a comment and sends it to the address of the smart contract, which further changes the state, i.e. data blockchain and sends a recommender reward. After this, transaction is considered completed. There is a limited period, after which the execution of the smart contract is forcibly completed. The recommender's interest is that the smart contract charges FBK tokens for providing information about living conditions.

6. The encrypted document is stored in the contract and sent to the public network Ethereum. We also propose the cost of paying for mining, which is expended on the launch of the changing function of the blockchain entrusted to the Aggregator.
7. You can consider modifying the work of a smart contract in which, in the event of negative feedback, tokens are written off from the tenant's wallet, and if positive, charges are written off. In the case of a low balance value, the landlord is invited to work on the errors, to refine the shortcomings. If the balance is reset, it disappears from the search results of the accommodation objects. In the future, you will need to prove that these disadvantages have been eliminated. Also a mechanism is needed to respond to negative reviews, which, however, will remain forever in the blockchain.

Thus, all parties are interested: tenants find guests (if they have positive feedback), recommenders receive tokens for their knowledge of living conditions, tenants and landlords have valuable information about possible accommodation facilities and the reputation of potential guests, and the aggregator increases confidence in their service and attracts new customers. See figure 3.

CONCLUSION

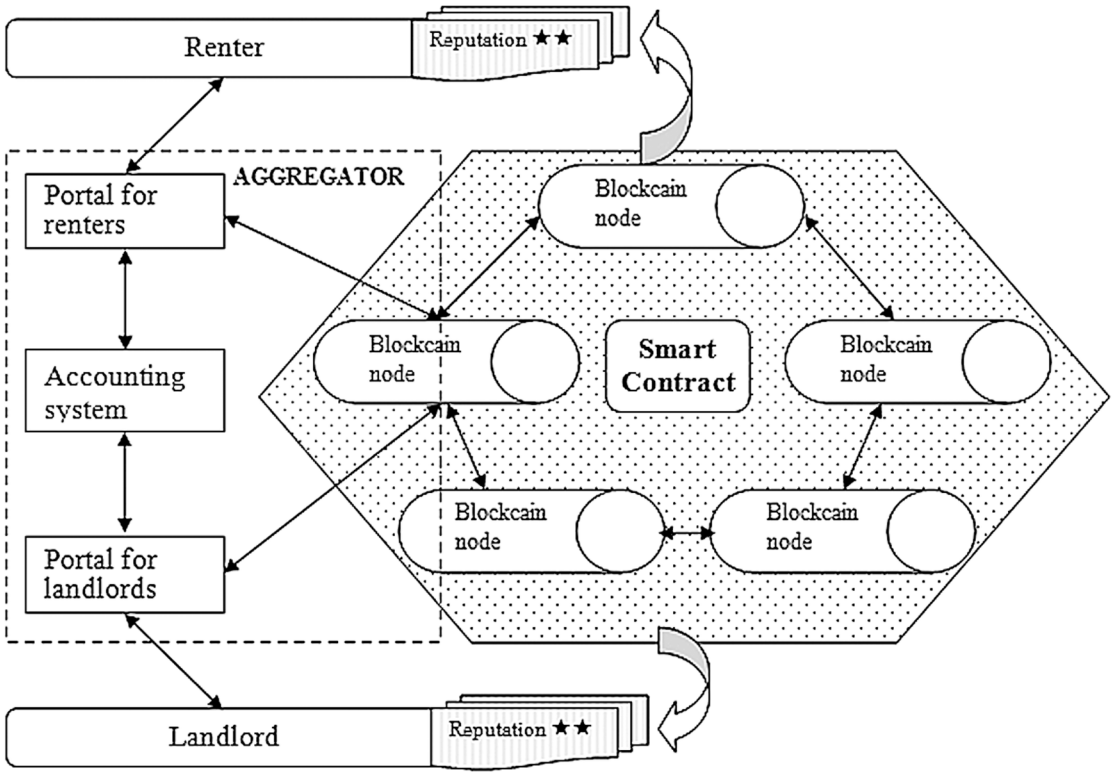
The modern rapid development of information and communication technologies initiates the increasingly active implantation of these tools into the system of interactions of the sharing economy subjects as a mechanism for the formation of genuine peer-2-peer social-market relations. The use of advanced, effective forms and methods of promoting products / services, communication with customers and partners, monitoring customer loyalty is becoming one of the key parameters for achieving success.

The research results suggest that the best technology in this perspective is the blockchain technology, which is organically integrated into the fundamental principles of sharing economy. The use of this technology in the management decision support system by the sharing economy subjects will undoubtedly improve the quality of the organization of their interaction system, achieve truly "breakthrough" results towards creating a socially oriented system of cooperation between equal actors.

The covid-19 pandemic gave new life to distributed computing technologies, which accelerated the processes of digitalization of society, changed world to "before" and "after". And blockchain has been improving the efficiency of business processes in current unstable macroeconomic situation (maybe one of the reason why bitcoin has surpassed its historical maximum of $ 50 is a huge investments in this sector).

The results of the research make it possible to change the view on the priorities of sharing economy subjects' decision-making process and formulate some recommendations for actors aimed at increasing the level of activity:

Figure 3. The interaction scheme



- application of the blockchain technology to the decision-making process;
- development of information and communication policy and its integration into a comprehensive development strategy;
- active contribution of freedom of information exchange.

The innovation effect from the use of the blockchain is demonstrated by the example of the objectification of the decision-making process on the choice of the counterparty of the sharing economy, based on decentralization and systemic multi-criteria assessment of the reputation of the subject / service of sharing economy.

FUTURE RESEARCH DIRECTIONS: USING BLOCKCHAIN TECHNOLOGY IN SHARING ECONOMY OPENS WIDE OPPORTUNITIES OF DEVELOPMENT IN DIFFERENT WAYS

For example, the FBK Token allows you to receive discounts on payment by users of accommodation, additionally provided services, transportation costs, food and beverages, etc. Landlords can pay commissions for the services of real estate aggregators, loyalty program services, using the FBK token. Real money is subsidized by the aggregator fund. It is impossible to mine FBK-coins in the usual way. Min-

ing is possible only with the help of a crypto processor: in order to be able to participate in the mining program, you must register and be the landlord of one of the properties participating in the consortium.

Another way to get FBK is to participate in an online platform on which users leave their feedback. All information enters the blockchain registry and is stored securely there. For such actions, participants receive rewards tokens.

We also suggest using tokens to vote for all important changes from the aggregator (1 token = 1 vote). Thus, the concept of tokenization not only links the coins directly with real estate objects, but also brings democratic values and increases the credibility of the aggregator.

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Chapter 9
Development of the Sharing Economy:
Factors, Effects, Motives of Participation

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ABSTRACT

This chapter examines the factors affecting the development of sharing economy. The purpose of this material is to identify and assess the factors of development of the sharing economy. As a result of this study, the formalization of the structure of factors influencing the development of the sharing economy is carried out, and the determinants of socially responsible behavior of subjects in the conditions of the sharing economy are determined. The formalization of the structure of factors influencing the development of the economy of joint use at the present stage was carried out by the methods of SWOT analysis. The research results allow to deepen the research in the field of the functioning of the sharing economy. The findings of the study are the basis for further research in the field of identification of stimulating factors for the development of the sharing economy and building effective business processes.

INTRODUCTION

The sharing economy is an innovation aimed at transforming the way businesses do business. This transformation entails serious economic consequences.

These changes include (Stolbov, 2018):

- increasing rationalization of consumer behavior. This is due to simplified access to information, which allows the consumer to make an informed choice. This maximizes utility;

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- complication of behavioral function. At present, people cannot be viewed only from the standpoint of the neoclassical model of homo economics, since they are characterized by "both egoism and altruism, both the desire for competition and the desire for cooperation ...".
- the difficulty of choosing in a large amount of information. Knowledge becomes the basic economic resource. A large amount of information and its abundance puts the consumer in an ambiguous situation related, on the one hand, with the possibility of obtaining meaningful information, and, on the other hand, the difficulty of determining truly meaningful information;
- the significance of the gravity model decreases, according to which a forecast of the distribution of the number of consumers in the market is made. In the traditional gravity model, the number of new consumers is inversely proportional to their distance from the place of transaction. In modern conditions, distance is no longer decisive. Increasingly, this factor is the cost of decision making.

Often, sharing economics is seen as a disruptive innovation (Ferrell and etc., 2017) that changes the market so much that the previously dominant state of affairs in the market and its habitual state is destroyed. The financial component is of fundamental importance. It has been proven that sharing economics destroys the familiar institutional environment and uses new technological solutions (Laurell & Sandström, 2016). Enterprises operating in these markets are forced to radically reconsider their business models. According to Richardson, L. this disruptive innovation strengthens traditional businesses (Richardson, 2015). This is necessary not only to maintain its competitiveness, but also simply to survive.

However, sharing economics, like any innovation, provides a number of social, environmental and economic benefits (Botsman & Rogers, 2011). From an environmental point of view, the economics of sharing implies a more rational and efficient use of various resources (Böcker & Meelen, 2017), makes it possible to save limited resources, and contributes to a longer use of goods. The economic benefits consist in reducing idle capacity, creating and promoting well-organized networks, changing the consumption model. Social effects consist in wider access to diverse services for socially vulnerable groups of the population due to cheaper access, increased social cohesion in society (Belk, 2010; Gansky, 2010).

Understanding the processes that form the basis of innovation, especially breakthrough innovation, helps in identifying the threats and opportunities that it represents (Druehl & Schmidt, 2008). Breakthrough innovations, to which the sharing economy belongs (Walsh, 2011), is a competitive response to the development of the economy and the market (Lepore, 2014). Therefore, studying economics of sharing is a strategically important activity from the point of view of building strategies for the functioning of business structures. At the same time, it should be borne in mind that J. Lepore proved that in the long run, the one who was able to accept, adapt and embed disruptive innovation in his business model more often wins, and not necessarily the one who was the first to promote a new destructive format (Lepore, 2014).

Moreover, economic sociology regards all sorts of strategic alliances, integration structures, centers of collective use as tools of subjugating the market to themselves, aimed at evading its influence (Baker, 1990; Pfeffer, 1987).

Currently, many models of the sharing economy are emerging in innovation with the aim of ensuring sustainable development (Ciulli & Kolk, 2019; Curtis & Mont, 2020). Much debate raises the question of the place and role of financial rewards in the sharing economy. Thus, Belk R. and Matofska B. argue that the sharing economy does not imply financial reward (Belk, 2007; Matofska). Other researchers believe the sharing economy allows for the monetization of unused resources (Paulus, 2019), or receive financial rewards for things that are of little value to the owners (Felländer, Ingram & Teigland, 2015).

The sharing economy promotes new business models into the business environment. This will ultimately increase employment and improve living standards.

Despite the large number of recent publications on the problems of the economics of sharing and its impact on growth and development, there are still many unexplored issues.

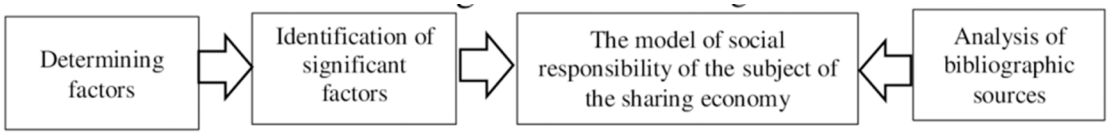
So, modern science knows little about which factors contribute to the development of a shared economy, and which factors hold back. Which of these factors are supportive, neutral and competitive in relation to each other? What are the motives for participation in the economy of sharing among various economic actors?

The purpose of this material is to identify and assess the factors of development of the economy sharing.

RESEARCH METHODS

Our research is driven by the logic presented in Figure 1.

Figure 1. Research logic



The study was carried out in accordance with the following stages.

1. To determine the most significant factors in the development of a shared economy. To identify the factors that influence the development of the sharing economy, the SWOT analysis methodology was used. Then selected factors were subject to ranking. The main survey lasted about two weeks and a total of 350 people were involved, who at least once used the services of companies that are subjects of the sharing economy. Expert opinion was summarized. Assessment of the consistency of expert opinions is carried out using the coefficient of concordance using the formula.e study was carried out in accordance with the following steps:

$$W = \frac{12d}{m^2\left(n^3 - n\right)}$$

where $d = \sum_{i=1}^{n} d_i^2 = \sum_{i=1}^{n} [\sum_{i=2}^{m} r_{ij} - 0.5m\left(n+1\right)]$

m - this is the number of experts, *n* - this is number of properties considered, r_{ij} - this is the place that took the *i-th* property in the ranking by the *j-th* expert; d_i - this is the deviation of the sum of ranks on the *i-th* property from the arithmetic mean of sums of ranks on n properties.

The calculated value of this coefficient was weighed according to the Pearson criterion with a certain level of significance.

To determine the rankings, the technology used to determine the relative importance of the criteria. To determine the relative importance of the criteria (K_i), the normalized iterated force is used:

$$K_i(q) = \frac{P_i(q)}{\sum_1^n P_i(q)}$$

where $P_i(q)$ - is an iterated *q-th* order force, which is determined by the formula.

$$P_i(q) = B \cdot P(q-1)$$

where *B* is the square matrix of estimates, calculated by the formula

$$B = b_{ij} \vee ;$$

When the matrix is compiled, the condition of "inverse symmetry" is fulfilled, which is described using the formulas:

$$b_{ji} = \frac{1}{b_{ij}} b_{ij} = \sum_1^M a_{ij} .$$

Where:

a_{ij} - is expert estimates;

M - is the total number of experts; *i=j=n*

2. On the basis of a theoretical analysis of literary sources, a model of social responsibility of the subject of the sharing economy has been formed.

The information area of the study was academic works and reviews on the economics of sharing and corporate social responsibility in Russian and English. Work on the economics of sharing has served as a source for identifying factors contributing to and hindering its development.

MAIN RESULTS

The study of the economics of sharing as a "sociocultural phenomenon of modernity" (Kuzmina, 2017) is carried out on the basis of the developed and well-founded fundamental principles:

- complexity and unwillingness to abandon the usual volume of consumed goods. The change in the socio-economic situation does not represent the ability to consume in the same amounts as before;
- the high cost of financial responsibility associated with the ownership of property;
- change of reference points from owning property to the consumption of benefits associated with the use of property;
- the use of value-oriented approach, aimed at responsible consumption with a focus on its ecologization.

The development of the economy of sharing is associated with the action of a whole set of factors. The main of them include (Kuzmina, 2017):

- Consumption crisis;
- Hyper consumption;
- Motivation for greening consumption;
- Economic crises;
- Technical progress;
- Consumer distrust of marketing technologies;
- Prosocial needs of the subjects;
- Needs of self-expression and activity.

The above is only a fraction of the factors. In addition to them, other factors of the external and internal environment also influence the development of the sharing economy, the use of which creates both advantages and limitations. To identify such factors apply SWOT-analysis. He is a «foundational assessment model that measures what an organization can and cannot do, and its potential opportunities and threats» (Grant, 2018).

We will study the results of SWOT analysis presented in the literature of companies that are leaders in sharing economics. The table shows the summary results of past empirical studies and found attributes that allow you to achieve success in your market.

Based on the presented results of the SWOT analysis, we make a ranking of factors. Let's make a pairwise comparison of factors. In tables from 3 to 6 we will present the final results of the assessment. The result of the comparison is obtained based on the majority of votes of experts participating in the assessment.

We translate the comparison results into quantitative indicators. For such a translation, we use the following rules: $a_{ij} = 1 + y$, if a $x_i > x_j$; $a_{ij} = 1 - y$, if a $x_i < x_j$; $a_{ij} = 1$, if a $x_i = x_j$, where is $y = 1$. The translation results will be presented in tables from 7 to 10.

We calculate the normalized iterated force. Based on its results, we can rank ascending. For "1" we take the largest weighting factor. The results are presented in tables from 11 to 14.

Table 1. Prior studies on successful business factors

Factor	Convention	Company				
		Facebook	Airbnb	Uber	Netflix	Alibaba
Strengths						
Availability of a unique clear business model	X_1	✓	✓	✓	✓	✓
The maximum possible availability of services / facilities for customers, regardless of location	X_2	✓	✓	✓	✓	✓
The possibility of reusable object	X_3	✓	✓	✓	✓	✓
Cheaper tariffs for the use of the object than in traditional companies	X_4	✓	✓	✓	✓	✓
Good awareness of current market trends	X_5	✓	✓	✓	✓	✓
Good consumer awareness	X_6	✓	✓	✓	✓	✓
Unlimited potential for investment in marketing, innovation, infrastructure and business expansion	X_7	✓	✓	✓	✓	✓
Users addicted to the service	X_8	✓			✓	
A large number of active users	X_9	✓	✓	✓	✓	✓
Oriented service works 24/7	X_{10}	✓	✓	✓	✓	✓
Extra ad revenue	X_{11}	✓	✓	✓	✓	✓
Well recognizable brand	X_{12}	✓	✓	✓	✓	✓
The trust	X_{13}	✓	✓	✓	✓	✓
Security	X_{14}	✓	✓	✓	✓	✓
Focusing on technology and development innovations	X_{15}	✓	✓	✓	✓	✓
Weaknesses						
High initial costs	Y_1	✓	✓	✓	✓	✓
A complex and inconvenient privacy model on a web site that is still not clear enough for many users.	Y_2	✓				
Low conversion rate	Y_3	✓	✓			✓
Low flexibility. The inability to make revolutionary changes due to the huge number of users (scale limits innovation).	Y_4	✓	✓	✓	✓	✓
The company generates almost all of its advertising revenue.	Y_5	✓	✓	✓	✓	✓
The idea is easily copied.	Y_6	✓	✓	✓	✓	✓
Low direct costs compared with indirect costs	Y_7			✓		
Low incentive for customers to stay with the company	Y_8	✓	✓	✓	✓	✓
Free cash flow reduction	Y_9				✓	✓
Dependence on the Chinese economy	Y_{10}				✓	
Originality above volume	Y_{11}				✓	

Source: (Report Barakaat Consulting, 2019 a; Report Barakaat Consulting, 2019 b; Report Barakaat Consulting, 2019 c; Report cayenneapps, 2019 a; Report cayenneapps, 2019 b; Report cayenneapps, 2019 c; Chatterjee & Fitch, 2018)

Table 2. Prior studies on successful business factors

Factor	Convention	Company				
		Facebook	Airbnb	Uber	Netflix	Alibaba
Opportunities						
Dissatisfaction with traditional services due to high prices and poor conditions	Z_1	✓	✓	✓	✓	✓
Changes in legislation and regulations	Z_2	✓	✓	✓	✓	✓
Good recommendations	Z_3	✓	✓	✓	✓	✓
Mobile market growth	Z_4	✓	✓	✓	✓	✓
The possibility of expanding operations in adjacent markets and the provision of additional services	Z_5	✓	✓	✓	✓	✓
Most of the content is concentrated on the World Wide Web.	Z_6	✓	✓	✓	✓	✓
The ability to generate advertising revenue	Z_7	✓	✓	✓	✓	✓
The ability to capture a large market share by entering new, large, serviceable markets	Z_8	✓	✓	✓	✓	✓
Threats						
Growing privacy issues	Q_1	✓	✓	✓	✓	✓
Advertising becomes less effective due to the reduction of people's susceptibility to it.	Q_2	✓	✓	✓		✓
Growing competition	Q_3	✓	✓	✓	✓	✓
Lawsuits and fines	Q_4	✓	✓	✓	✓	✓
In the future, new concepts may emerge that will replace object sharing technology.	Q_5	✓	✓	✓	✓	✓
High and still rising transaction costs	Q_6	✓	✓	✓	✓	✓
Radical changes in consumption habits	Q_7	✓	✓	✓	✓	✓
Unpredictable stock prices. Dependence on investor expectations.	Q_8	✓	✓	✓	✓	✓
Increasing the number of fakes can affect core competencies.	Q_9		✓	✓		✓

Source: (Report Barakaat Consulting, 2019 a; Report Barakaat Consulting, 2019 b; Report Barakaat Consulting, 2019 c; Report cayenneapps, 2019 a; Report cayenneapps, 2019 b; Report cayenneapps, 2019 c; Chatterjee & Fitch, 2018)

Table 3. Comparison results for the group "Internal Environment Factors (Strengths)"

Factors of the internal environment (Strengths)	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
X_1	=	<	<	<	<	<	<	>	<	<	<	=	<	<
X_2	>	=	<	=	<	=	=	>	=	<	<	=	=	=
X_3	>	>	=	>	>	>	>	>	>	>	>	>	>	>
X_4	>	=	<	=	>	=	>	>	=	<	>	>	>	>
X_5	>	>	<	<	=	>	=	>	=	<	<	=	=	<
X_6	>	=	<	=	<	=	<	>	<	<	>	>	>	=
X_7	>	=	<	<	=	>	=	>	=	<	<	=	=	=
X_9	<	<	<	<	<	<	<	=	<	<	<	<	<	<
X_{10}	>	=	<	=	=	>	=	>	=	<	=	=	=	<
X_{11}	>	>	<	>	>	>	>	>	>	=	>	>	>	>
X_{12}	>	>	<	<	>	<	>	>	=	<	=	=	=	=
X_{13}	=	=	<	<	=	<	=	>	=	<	=	=	=	=
X_{14}	>	=	<	<	=	<	=	>	=	<	=	=	=	=
X_{15}	>	=	<	<	>	=	=	>	>	<	=	=	=	=

Source: compiled by the author.

Table 4. Comparison results for the group "Internal Factors (Weaknesses)"

Factors of the internal environment (Weaknesses)	Y_1	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8	Y_9
Y_1	=	>	<	<	>	<	>	>
Y_3	<	=	<	<	>	<	>	>
Y_4	>	>	=	<	>	<	>	=
Y_5	>	>	>	=	>	<	>	>
Y_6	<	<	<	<	=	<	=	=
Y_7	>	>	>	>	>	=	>	>
Y_8	<	<	<	<	=	<	=	=
Y_9	<	<	=	<	=	<	=	=

Source: compiled by the author.

As a result of ranking factors in each group, the most significant factors were identified. The contributing factors in the group of internal factors include: a large number of active users; the presence of a unique clear business model; the trust. In the group of external factors - the ability to seize a large market share by entering new, large, serviceable markets; the possibility of expanding operations in adjacent markets and the provision of additional services; dissatisfaction with traditional services due to

high prices and poor conditions. The factors that hold back development in the group of internal factors include: the idea is easily copied; low incentive for customers to stay with the company; decrease in free cash flow; low conversion rate. In the group of external factors - growing competition; in the future, new concepts may emerge that will replace the object sharing technology; dependence on investor expectations. Unpredictable stock prices.

Table 5. Comparison results for the group "Environmental Factors (Opportunities)"

Environmental factors (Opportunities)	**Z_1**	**Z_2**	**Z_3**	**Z_4**	**Z_5**	**Z_6**	**Z_7**	**Z_8**
Z_1	=	<	<	=	>	<	<	=
Z_2	>	=	<	>	>	>	>	>
Z_3	>	>	=	>	>	>	=	>
Z_4	=	<	<	=	=	=	<	>
Z_5	<	<	<	=	=	<	<	>
Z_6	>	<	<	=	>	=	=	=
Z_7	>	<	=	>	>	=	=	>
Z_8	=	<	<	<	<	=	<	=

Source: compiled by the author.

Selected key factors in relation to each other may have a different character. Some factors may reinforce each other's actions, others compete with each other. There are neutral factors that do not directly affect each other. In Figure 2, we present the results of such a comparison.

Table 6. Comparison results for the group "Environmental Factors (Threats)"

Environmental factors (Threats)	**Q_1**	**Q_2**	**Q_3**	**Q_4**	**Q_5**	**Q_6**	**Q_7**	**Q_8**	**Q_9**
Q_1	=	<	>	=	>	<	=	=	<
Q_2	>	=	>	>	>	>	>	>	=
Q_3	<	<	=	<	=	<	<	<	<
Q_4	=	<	>	=	>	>	=	>	=
Q_5	<	<	=	<	=	=	=	=	<
Q_6	>	<	>	<	=	=	=	>	<
Q_7	=	<	>	=	=	=	=	=	<
Q_8	=	<	>	<	=	<	=	=	<
Q_9	>	=	>	=	>	>	>	>	=

Source: compiled by the author.

Table 7. Comparison Estimates for the Group "Internal Environment Factors (Strengths)"

Factors of the internal environment (Strengths)	**X_1**	**X_2**	**X_3**	**X_4**	**X_5**	**X_6**	**X_7**	**X_9**	**X_{10}**	**X_{11}**	**X_{12}**	**X_{13}**	**X_{14}**	**X_{15}**
X_1	1	0	0	0	0	0	0	2	0	0	0	1	0	0
X_2	2	1	0	1	0	1	1	2	1	0	0	1	1	1
X_3	2	2	1	2	2	2	2	2	2	2	2	2	2	2
X_4	2	1	0	1	2	1	2	2	1	0	2	2	2	2
X_5	2	2	0	0	1	2	1	2	1	0	0	1	1	0
X_6	2	1	0	1	0	1	0	2	1	1	2	2	2	1
X_7	2	1	0	0	1	2	1	2	1	0	0	1	1	1
X_9	0	0	0	0	0	0	0	1	0	0	0	0	0	0
X_{10}	2	1	0	1	1	2	1	2	1	0	1	1	1	0
X_{11}	2	2	1	1	2	1	2	2	1	0	1	1	1	1
X_{12}	2	2	1	1	2	0	2	2	1	0	1	1	1	1
X_{13}	1	1	0	0	1	0	1	2	1	0	1	1	1	1
X_{14}	2	1	0	0	1	0	1	2	1	0	1	1	1	1
X_{15}	2	1	0	0	2	1	1	2	2	0	1	1	1	1

Source: compiled by the author.

Table 8. Comparison Estimates for the "Internal Factors (Weaknesses)" group

Factors of the internal environment (Weaknesses)	**Y_1**	**Y_3**	**Y_4**	**Y_5**	**Y_6**	**Y_7**	**Y_8**	**Y_9**
Y_1	1	2	0	0	2	0	2	2
Y_3	0	1	0	0	2	0	2	2
Y_4	2	2	1	0	2	0	2	1
Y_5	2	2	2	1	2	0	2	2
Y_6	0	0	0	0	1	0	1	1
Y_7	2	2	2	2	2	1	2	2
Y_8	0	0	0	0	1	0	1	1
Y_9	0	0	1	0	1	0	1	1

Source: compiled by the author

The development of the sharing economy occurs in the framework of social responsibility. Adapting A. Carroll's (Carroll, 1979) model of corporate social responsibility, we can distinguish the range of responsibility of the subject in the sharing economy:

Table 9. Comparison Estimates for the group "Environmental Factors (Opportunities)"

Environmental factors (Opportunities)	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7	Z_8
Z_1	1	0	0	1	2	0	0	1
Z_2	2	1	0	2	2	2	2	2
Z_3	1	0	0	1	1	1	0	2
Z_4	1	0	0	1	1	1	0	2
Z_5	0	0	0	1	1	0	0	2
Z_6	2	0	0	1	2	1	1	1
Z_7	2	0	1	2	2	1	1	2
Z_8	1	0	0	0	0	1	0	1

Source: compiled by the author.

Table 10. Comparison Estimates for the group "Environmental Factors (Threats)"

Environmental factors (Threats)	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Q_7	Q_8	Q_9
Q_1	1	0	2	1	2	0	1	1	0
Q_2	2	1	2	2	2	2	2	2	1
Q_3	0	0	1	0	1	0	0	0	0
Q_4	1	0	2	1	2	2	1	2	1
Q_5	0	0	1	0	1	1	1	1	0
Q_6	2	0	2	0	1	1	1	2	0
Q_7	1	0	2	1	1	1	1	1	0
Q_8	1	0	2	0	1	0	1	1	0
Q_9	2	1	2	1	2	2	2	2	1

Source: compiled by the author.

Table 11. The definition of the ranks of influence on the group "factors of the internal environment (Strengths)"

Calculation Parameters	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
The value of the cells of the matrix-column	292	175	18	72	151	146	155	359	157	19	120	190	166	124
The sum of the numbers in the matrix column	2144													
Weights	0,14	0,08	0,01	0,03	0,07	0,07	0,07	0,17	0,07	0,01	0,06	0,09	0,08	0,06
Rank	2	4	8	7	5	5	5	1	5	8	6	3	4	6

Source: compiled by the author.

Table 12. Determination of the ranks of influence in the group "Internal Factors (Weaknesses)"

Calculation Parameters	Y_1	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8	Y_9
The value of the cells of the matrix-column	27	43	26	5	90	1	90	84
The sum of the numbers in the matrix column	366							
Weights	0,07	0,12	0,07	0,01	0,25	0,00	0,25	0,23
Rank	4	3	4	5	1	6	1	2

Source: compiled by the author.

Table 13. Determination of the ranks of influence on the group "environmental Factors (Opportunities)"

Calculation Parameters	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7	Z_8
The value of the cells of the matrix-column	57	1	4	48	65	36	13	82
The sum of the numbers in the matrix column	306							
Weights	0,19	0,00	0,01	0,16	0,21	0,12	0,04	0,27
Rank	3	8	7	4	2	5	6	1

Source: compiled by the author.

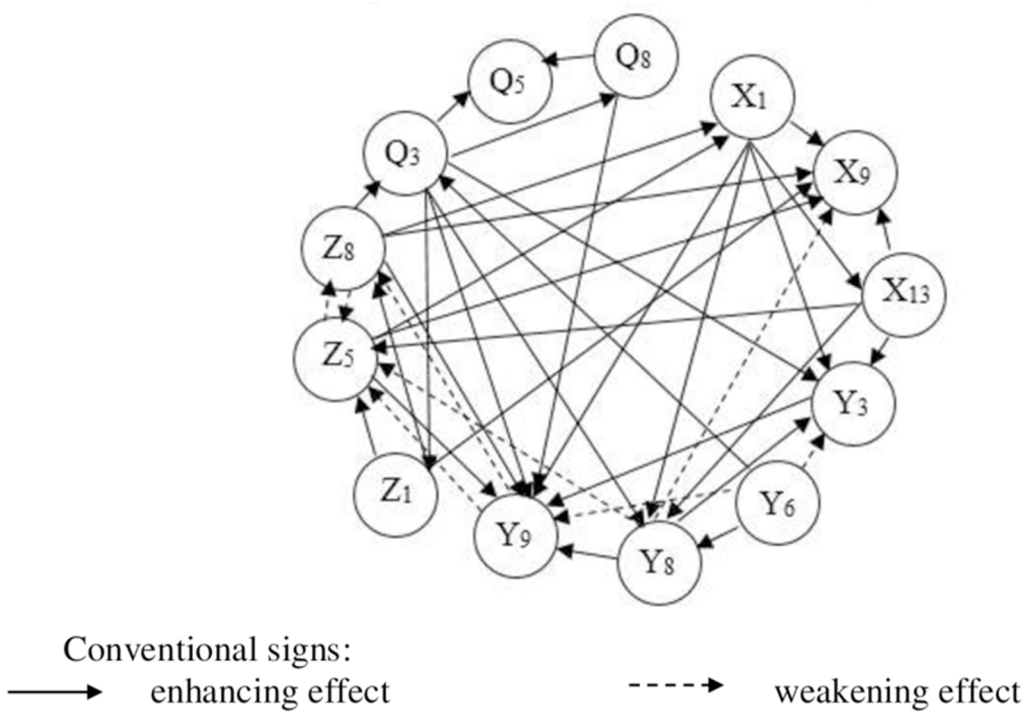
- economic responsibility is to meet the needs of society on a different qualitative basis and receive profit from this. It is the financial component that is of fundamental importance. From a financial point of view, it becomes more profitable to use than to own;
- legal responsibility is to fulfill economic and social obligations within the existing legal framework;
- ethical responsibility reflects the observance of codes, norms and values, rules of behavior that exist in society and operate within the framework of formal and informal legislation. At the heart of the social responsibility of the subject of the sharing economy are norms, such as truthfulness, compulsion, reciprocity. These rules are elements of self-regulation. They are more flexible than formal norms; easier to adapt to changing operating conditions; open up opportunities to create comfortable conditions for the functioning of business structures; aimed at maintaining high standards of business operation; allow you to better adapt to the specific conditions of operation.

Table 14. The definition of the ranks of influence on the group "environmental Factors (Threats)"

Calculation Parameters	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Q_7	Q_8	Q_9
The value of the cells of the matrix-column	66	5	133	33	102	54	70	85	11
The sum of the numbers in the matrix column	559								
Weights	0,12	0,01	0,24	0,06	0,18	0,10	0,13	0,15	0,02
Rank	5	9	1	7	2	6	4	3	8

Source: compiled by the author.

Figure 2. Graph of comparative aggregate assessment of key factors for the development of economic entities sharing



The social responsibility of a sharing economy has the following structure:

a) personal ethics, implying responsibility for the usefulness of the product being created and promoted. The subject is expected to have high demands on the reliability of the material, correctness in the use of the work of other subjects. The economic subject of joint use in its activities is guided by the conditions necessary for creating a new / improved product / service, its consolidation, distribution in society, use for solving existing problems, etc.;
b) moral responsibility. Since the subject of the sharing economy most often does not work alone, it is responsible for the moral atmosphere, for the existing culture of mutual relations, communication, cooperation, mutual assistance, etc. Particular attention is paid to the moral motivation of activity. It is divided into three levels (from higher to lower):
   - the first, on which the dominant motives are disinterested service to the society, the desire to benefit people and other altruistic motives;
   - the second, where the activity is prompted by the arrogant desire to seize a larger market volume, to achieve leadership by any means, not excluding the way of appropriating the results of joint activities and foreign intellectual property, etc. Here, egoistic motives are decisive;
   - the third, when the motives of activity are the tasks set by programs and projects, and requiring mandatory execution. Then the subject becomes a "soldier without form";
c) specific professional responsibility.

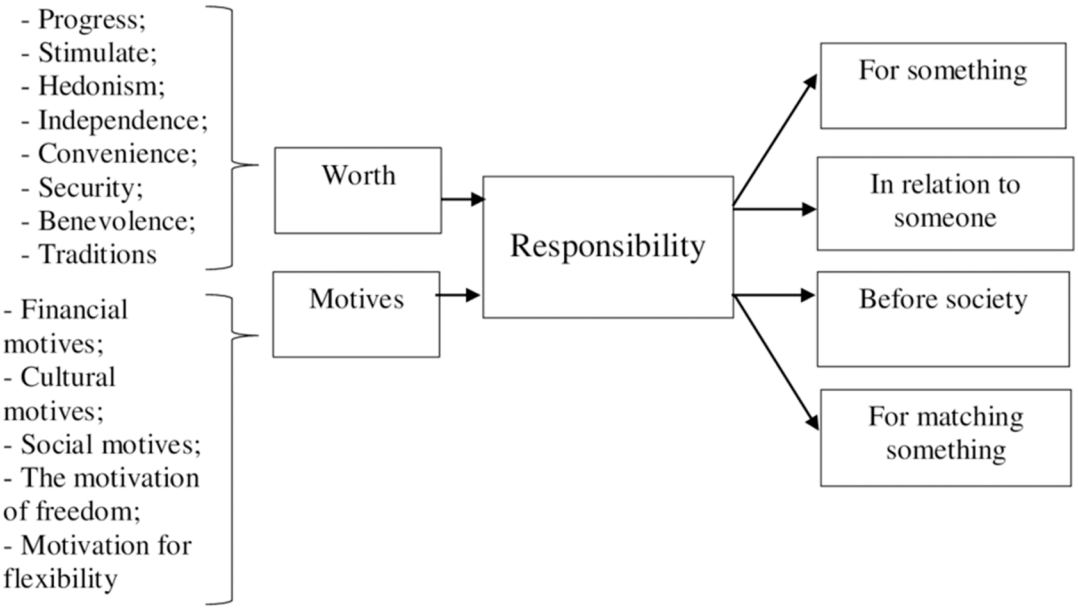
It should be noted that the cultural component for the development of a shared economy is decisive. The main element of the culture of the subjects of the sharing economy are both the dominant human values and the value orientations of the participants, which are realized in their socially responsible or socially irresponsible behavior (Figure 3). Motivation also influences responsibility.

Signs of a formed culture of social responsibility of the subject of the sharing economy are: the presence of rational constraints on its innovative activity; the introduction of the dominant values of social responsibility; presence of motivation and sustained interest, etc.

The fundamental principle of social responsibility of the subject of the sharing economy is strict compliance with the law. This activity constitutes the basic legal level of socially responsible behavior.

A special place is given to regulated responsibility - the second level of responsibility. Regulated liability is implemented through technological regulation, which is based on technical regulations. They represent a list of mandatory requirements and restrictions imposed on the technical parameters of the technologies used, consumer products and services, established by the state over time, and their rigidity increasing with time.

Figure 3. Responsibility model of a sharing economy
Source: (Schwartz,1987; Schwartz, 2001; Yasin & Lebedeva, 2009; Loseva & Fedotova, 2016; Zhang and ets, 2019)



The third level of social responsibility of a sharing economy can be considered its functional level, when it assumes certain voluntary commitments in order to bring effect in the short and medium term. Here we are talking about the use of more advanced requirements for the parameters of the applied technologies that are not legally fixed.

A higher level of responsibility consists in introducing the principles of social responsibility into the company's development strategy, focusing on the long-term perspective.

The introduction of new technologies leads to the expansion and transformation of the entire field of responsibility. At the same time, the introduction and application of the concept of social responsibility is an incentive for the further sustainable development of the sharing economy.

DISCUSSION AND CONCLUSION

Our results confirmed the results of studies by other scientists who raise questions about the development of the sharing economy.

As a result of this study, the formalization of the structure of factors influencing the development of the sharing economy is carried out, the determinants of socially responsible behavior of subjects in the conditions of the sharing economy are determined. The formalization of the structure of factors influencing the development of the economy of joint use at the present stage was carried out by the methods of SWOT analysis.

Understanding the factors of the development of a shared economy and the determinants of socially responsible behavior of the subjects will contribute to building their business models in a shared economy.

Work on corporate social responsibility (JI) has allowed building a conceptual model of JI of a business entity operating in a sharing economy. This model reflects the values of a particular individual and a certain community, types of responsibility (personal, moral and professional), levels of responsibility (basic legal level, regulated level of responsibility, functional level). It is proved that the level of social responsibility directly depends on the level of culture.

Based on the combination of the key factors of the development of the sharing economy and the JI model of the business entity, the motives for participation in the economy of the joint use of various economic agents are determined. The key integral indicators underlying decision making are the credibility indicator and the confidence factor.

The results of this study are important. Based on knowledge of the stimulating and limiting factors of development, the positive effects and threats of the sharing economy, rational solutions can be found to compensate for the destructive impact of this breakthrough innovation on traditional industries and markets. The results can be used in the activities of business structures in building a business model of its operation in the sharing economy. The study proved that social responsibility is the basis for making decisions about participation in the sharing economy. Also, the results of the study may be useful to public authorities, since a sharing economy requires regulating and taking into account not only the interests of structures that are active participants in sharing economics, but also the interests of existing business structures operating on the basis of customary business models.

The research results allow to deepen the research in the field of the functioning of the sharing economy. The findings of the study are the basis for further research in the field of identification of stimulating factors for the development of the economy of sharing and building effective business processes.

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Chapter 10
Measuring the Impact of SAP R/3 Implementation to Efficiency of Process Business on the Paper Manufacturing Industry

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ABSTRACT

This study aims to improve the sales business processes of paper manufacturing industry. While manual systems are still used in the company operations utilized today, this study would enhance the business process with the ERP system approach. This analysis uses methods of exploration, interviews, and literature reviews on business process growth. The findings of this study include a new design of business processes and suggestions for business processes that meet the needs of the paper manufacturing ERP system.

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1 INTRODUCTİON

It is now almost impossible in many modern organizations to sustain business processes if the company does not have an integrated IT / IS framework. Without the help of a good business process management system to enhance business efficiency and customer loyalty, companies do not function well. A business method is essentially seen as an art rather than a science that can be researched and measured. Based on (Akkiraju et al., 2001; Bergman et al., 2002), a full and dynamic collaborative and transactional operation is the concept of business processes and is organized to provide consumers with more value. While other views suggest that a business process is a series of activities conducted to achieve the desired performance of the business (Bergman et al., 2002). In the beginning and the end, time and place, and the required input and output to be generated, business processes should be clearly defined. In an enterprise, the use of Information Systems and Technology (IST) is an indispensable part of business process growth. Technology (SI/IT) can also simplify and speed up all operational activities in the organization. Performance and effectiveness are the keys to a business process that can be assumed to be effective or that there is at least no change in the business processes of the company (Bender et al., 1981; Bredström et al., 2004).

According to (Bredström et al., 2005; Carlgren et al., 2006), in a business process management project, the stage of change is the most innovative stage. Creativity is a form of natural product that can not be substituted by a machine and is generated by humans. Enterprise Resource Planning (ERP) is a technology that can help business processes become more systematic and speed up business processes and continually enhance and track the value chain of the organization. Implementation of ERP will offer the organization benefits, including reducing cycle time, enhancing business flow performance, and rapidly producing financial information to help managers monitor the entire business process and speed up the decision-making process (Carlsson & Fueller, 2000; Carlsson & Rönnqvist, 2006; Chauhan et al., 2006). We have taken as our study object three paper manufacturing businesses. These are the Indonesian manufacturing companies that have several ventures in Surabaya and Jakarta. On the basis of the current situation, in particular the Covid 19 pandemic, these organizations need to introduce an information system to assist existing business processes in order to establish business processes in order to boost the competitiveness of digital businesses (Chauhan et al., 2006; Correia et al., 2004; De Treville & Shapiro, 2003).

The need for digital transformation would enable these manufacturing businesses to be more competitive and sustainable. In industries that still use manual systems where the position of people is very prominent, many business processes also produce a lot of mistakes caused by human error. It would take a lot of human labor if administrative work is too costly for the admin workers. Due to a lack of knowledge among sales people in the field with financial parties on the measurement of how to pay for a home purchase, there was also a problem (Everett et al., 2001; Everett et al., 2000; Stadtler et al., 2002).

2 PAPER MANUFACTURE INDUSTRY

The commercial activities of the companies began in 1989, using Paper Machine 2 (PM2) to manufacture linerboards. Paper Machine 1 (PM1) started producing coated duplex boards in 1990, and a third paper machine (PM3) started manufacturing corrugated media in 1995 (Flisberg et al., 2002; Forsberg et al., 2005; Frisk et al., 2006; Goulimis, 1990). The company built its first power station (Cogen1) with a

capacity of 32,5 megawatts in the same year. A fourth paper machine, PM7, was completed in 2006 and updated in 2012, manufacturing containerboard (corrugated medium and linerboard). A second power plant (Cogen2) was installed with a 35 MW capacity. In December 2010, a fifth paper computer (PM5) praised the activities (Gunasekaran & Ngai, 2004; Gunasekaran & Ngai, 2005; Gunnarsson et al., 2006a; Gunnarsson et al., 2006b).

Through the use of a new range of super strong and lightweight material, the completion of PM8 would improve containerboard paper production in 2017 (Keskinocak et al., 2002). The numbering of the paper machines is not sequential, and we do not own or own PM4 and PM6 as of the date of this Annual Report (Martel et al., 2005). In addition, the company is also linked to the 30 MW grid of the state-owned electricity company that serves as a backup power supply with access to energy (Martel et al., 2004; McIntyre, 2005).

Figure 1. Paper mill, Cibitung (Shapiro, 2004)

Through the use of a new range of super strong and lightweight material, the completion of PM8 would improve containerboard paper production in 2017 (Menon & Schrage, 2002; Murthy et al., 1999). The numbering of the paper machines is not sequential, and we do not own or own PM4 and PM6 as of the date of this Annual Report]31, 32]. In addition, the company is also linked to the 30 MW grid of the state-owned electricity company that serves as a backup power supply with access to energy (Rizk et al., 2006a).

Figure 2. Process Production Cross SAP R/3 Application(Shapiro, 2001)

3 MEASURİNG EFFİCİENCY

Data Development analysis (DDA) uses a linear programming-based model to calculate the relative efficiency of decision-making units (DMUs) with multiple inputs and multiple outputs. The technique is non-parametric since the weights of the underlying production function (Weintraub & Romero, 2006) do not require any inference. In addition, the DEA does not require the prescription of the functional types

of the relationships between inputs and outputs required in the approaches to statistical regression, and the variables can be calculated in various units (Weigel et al., 2006).

It is possible to define the set of effective DMUs that form the productive frontier. DEA is therefore also a good benchmarking technique, since it enables the degree of efficiency of non-frontier units to be calculated and benchmarks to be contrasted with those inefficient units (Gunasekaran & Ngai, 2004) to be established (Westerlund et al., 1998).

DEA has also been commonly used in various industries, and a range of different DEA models have been produced and enhanced based on the original DEA mode.

$$MAX \frac{\sum_{r-1}^{s} u_r y_{r0}}{\sum_{i-1}^{m} v_i x_{i0}} \quad 1$$

$$\text{S.t.} \frac{\sum_{r-1}^{s} u_r y_{rj}}{\sum_{i-1}^{m} v_i x_{ij}} \leq 1 \forall j \quad 2$$

$$u_r \geq \varepsilon, \quad 3$$

$$v_i \geq \varepsilon, \quad 4$$

Using the aid of DEA software, the mathematical equation is then processed. Between 0.0000 and 1.0000, relative efficiency values generated using the DEA CRS model are generated. So if anyone has an efficiency value of 1,0000, this DMU is declared efficient, whereas the DMU is declared inefficient if it has an efficiency value below 1,0000(Wilhelmsson et al., 2002).

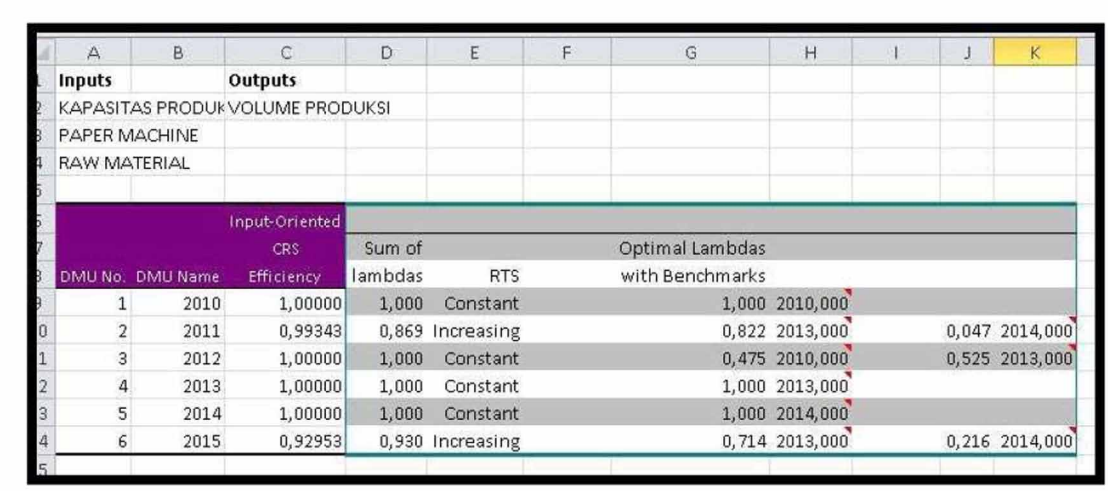
4 RESULTS AND LESSONS LEARNT

Following are the results of DEA measurements for each period, where the results of these measurements illustrate the value of efficiency in each period.

Table 1. Data for each DMU Including Production Capacity, Raw Material and Volume Production in the Manufacturing industry during the period 2010 to 2015

Division	Period	Production Capacity	Raw Material	Volume Production
Production Planning	2010 Before	1.000.000	986.859	729.513
	2011 Before	1.050.000	1.329.150	914.226
	2012 Before	1.200.000	1.257.237	896.749
	2013 After	1.200.000	1.502.086	1.048.346
	2014 After	1.200.000	1.813.321	1.110.710
	2015 After	1.200.000	1.574.340	987.927

Figure 3. DEA Frontier application



	A	B	C	D	E	F	G	H	I	J	K
1	**Inputs**		**Outputs**								
2	KAPASITAS PRODUK		VOLUME PRODUKSI								
3	PAPER MACHINE										
4	RAW MATERIAL										
5											
6			Input-Oriented								
7			CRS	Sum of			Optimal Lambdas				
8	DMU No.	DMU Name	Efficiency	lambdas	RTS		with Benchmarks				
9	1	2010	1,00000	1,000	Constant		1,000	2010,000			
10	2	2011	0,99343	0,869	Increasing		0,822	2013,000		0,047	2014,000
11	3	2012	1,00000	1,000	Constant		0,475	2010,000		0,525	2013,000
12	4	2013	1,00000	1,000	Constant		1,000	2013,000			
13	5	2014	1,00000	1,000	Constant		1,000	2014,000			
14	6	2015	0,92953	0,930	Increasing		0,714	2013,000		0,216	2014,000
15											

Table 2. Data for each DMU Including Production Capacity, Raw Material and Volume Production in the Manufacturing industry during the period 2010 to 2015

Division	Period	Score	Description
Production Planning	2010 Before	1	Period before SAP R/3 implementation
	2011 Before	0.993	Period before SAP R/3 implementation
	2012 Before	1	Period before SAP R/3 implementation
	2013 After	1	Period After SAP R/3 implementation
	2014 After	1	Period After SAP R/3 implementation
	2015 After	0.929	Period After SAP R/3 implementation

5 TARGET OF ESTABLİSHİNG INPUT / OUTPUT IMPROVEMENTS

Efforts to improve input-output are done so that the DMU that is not efficient becomes efficient. As for DMUs that are already efficient, this method is carried out to maintain their level. Improvement of input-output is done by setting an input-output target.

There are two choices to determine the input and output improvement target so that an efficient DMU becomes efficient, namely input maximization and output maximization. In input maximization see the extent to which the value of the input can be reduced and still maintain the value of output, while output maximization see the extent to which the value of output can be added by maintaining the value of the input.

In this study the output maximization method was chosen, because the consideration of the majority of variables is not easy to reduce such as the number of employees. The process to reduce the value of these variables is very selective.

After that set the target of the input variable and output variable values that have not been efficient so as to produce a score of 100% or efficient. If the target value of the input variable is smaller than the actual column, it means that there is waste in allocating the input variable, whereas if the target value of the output variable is greater than the actual column, it means that the output value is not maximized by the value of the input variable allocated.

Table 3. Actual Value, Target, and Potential Improvement in DMU 2011 Before

Period	Input Output	Value	Target	Potential Improvement
2011 Before	Productiion Capacity	1.050.000	1.050.000	0%
	Paper Machine	5	5	0%
	Volume Production	914.226	917.229	0.3%
	Raw Material	1.329.150	1.333.516	0.3%

To achieve a score of 100% or an efficient value in the 2011 DMU Before (2011 Period before the implementation of the SAP R / 3 ERP system) can be done by increasing the output value on the variable VP (Total Volume Production in tons) to 917,229, or in other words the actual condition on the VP variable can reach the target if the VP variable value is added as much as 0.3%, and increase the output value on the variable RW (Raw Material) to 1,333,516, or in other words the actual condition on the variable RW can reach the target if the value of the RW variable is added as much as 0.3%.

Table 4. Actual Value, Target, and Potential Improvement in DMU 2015 After

Period	Input Output	Value	Target	Potential Improvement
2015 After	Productiion Capacity	1.200.000	1.200.000	0%
	Paper Machine	5	5	0%
	Volume Production	987.927	1.022.736	0.3%
	Raw Material	1.574.340	1.629.811	0.3%

To achieve a score of 100% or an efficient value on the 2015 DMU Before (Period 2015 before the implementation of the SAP R / 3 ERP system) can be done by increasing the output value on the variable VP (Total Volume Production in tons) to 1,022,736, or by in other words the actual condition on the VP variable can reach the target if the VP variable value is added by as much as 0.3%, and increase the output value on the variable RW (Raw Material) to 1,629,811, or in other words the actual condition on the RW variable can reach the target if the variable value RW added by 0.3%.

6 DİSCUSSİON

It was concluded that the SAP R/3 ERP system would allow the paper manufacturing industry to integrate knowledge from different business processes in the Data Development Analysis (DDA) study in the implementation of SAP SAP R/3 in the paper manufacturing business process. In addition, to promote the manufacturing industry, it also offers centralized data links to perfect the presentation of data. We may infer that the implementation of SAP R/3 makes the company's manufacturing sector more effective.

Most instances of SAP ERP R/3 deployment are effective, but SAP SAP R/3 deployment is not always effective in achieving support for the efficiency of the business. There are several firms that have failed to integrate SAP SAP R/3 schemes.

Moreover, it is very important to analyze and quantify the application of the ERP R/3 method for the efficiency of manufactured production process in order to learn about the value of efficiency in company operations before and after the deployment of the ERP system. This research was performed using the DDA (Data Creation Analysis) method using the program Banxia Frontier Analysis. According to Chauhan (2006) (Chauhan et al., 2006), DEA (Data Envelopment Analysis) is specifically designed to measure the performance of the production unit in large numbers of inputs and multiple outputs, which is more difficult to address openly with technical analysis of other efficiency adjustments.

One of the crucial problems in this method is how to measure variable input and output variables that do not specify variables in the calculation of input and output parameters, so that they determine input and output variables and are very subjective. However, the input variables are typically calculated according to the DMU (Decision Making Unit) as resources used (Ramanathan, 2003), while the temporarily output is the gain generated as a result of activities carried out in the DMU (Decision Making Unit).

When input and output variables are measured in this study, there are many things that must be agreed upon, including: parameters input and output that used are components that influence the effectiveness of a company process and include many DMUs (Decision Making Units) where each DMU (Decision Unit) is 2 periods before the ERP is implemented and 2 periods after the deployment

The variable inputs used in this study are the aggregate of production capacity in tons, and the quantity of paper machines in the unit in the production planning division. Based on the variable manufacturing capacity and the number of machines involved in the division planning process, without the number of machines and production capacity, the variables chosen in this study as input variables are not capable of carrying out production activities, while the output variable used in this study is the quantity of tons of production planning divisions. These variables are chosen because they are the result of business processes carried out by the production planning division.

7 CONCLUSION

When refer to review of the results of the performance calculation was carried out in the previous section, it can be determined that the implementation of SAP R/3 in the pulp and paper fabricate division planning sector must be effective after the ERP has been implemented compared with the duration before the ERP was implemented. Before and after the ERP implementation, the calculation of each DMU can be seen, while the DMU that was accepted was 79.15 percent in the time before the ERP implementation, whereas the DMU was 96.67 percent after the SAP R/3 implementation.

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Chapter 11
Unregulated Use of Blockchain Technologies in the Financial Markets

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ABSTRACT

The chapter studies the problem of a possible influence of the unregulated use of blockchain technology on financial markets and regulation. The authors proceed from the assumption that development of new technologies used in financial markets is of great importance and, at the same time, see a threat to the stable functioning and regulation of financial institutions, primarily credit institutions. The correct solution of the question of the necessity and the limits of regulation of the blockchain technology usage in financial markets, in the authors' opinion, should be considered a factor of the financial markets' competitiveness improving.

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INTRODUCTION

Articulation of Issue

Contradictions accumulated in the domain of data formation, storage, accounting, transfer and safety have given rise to steady expectations for the participants of economic life relating to their resolution, which is connected primarily with the distributed ledger technology. More precisely, with one aspect of those, viz., the blockchain technology. It should be noted that the distributed ledger technologies are not only blockchain technology, but also databases. In this sense, the most significant question is whether these expectations are met at all. If yes, the problem is whether they can prove their value in practice, and what are the risks of the technology utilization.

Blockchain is a special technology on which platforms are founded for conducting operations between equal participants acting without a third party. The given technology employs decentralized information security for the display of all data within the operation. This is a distribution database and there are many copies of it. The following suppositions lie at the base of the technology' working algorithm:

1) All data chains are cached.
2) This data forms into blocks connected with one another.
3) Every data chain is founded on the solution to a mathematical problem.
4) Copies of the list (blocks and chains) are saved on many computer's hard drives.

Pioneer application of blockchain technology was in the financial sector, where it served as the basis for the creation of Bitcoin cryptocurrency, and has already reached a definite level of maturity. In comparison with other industries, in the financial sector solutions on the base of Blockchain are used: developed not only by significant populations, but also by mature players, for example, international commercial banks.

At the current moment the appearing application are broadening the key function of data technology – decentralized data security in transactions on account of the integration of mechanisms which allow real deals to be transferred by decentralized means.

The data mechanisms acquired the title «smart contracts». They work based on rules set up in individual order (for example, concrete demands in respect to quantity, quality, and value) and permitting the distributed registries, in an automatic regime, to select potential users for providers and vice versa.

Thanks to blockchain technology, the order of conducting operations is changing: a gradual transfer from the use of centralized structures (banks, stock exchanges, trading platforms, and the like) to the intentional use of a decentralized system is occurring. Operations are now conducted directly between equal parties in the network (P2P networks), which leads to a release from transactions with third parties. In the field of financial services, transaction models based on blockchain can provide a serious reduction of waste and increase in effectiveness and expedition of the processes. In result, the whole system becomes more flexible, since many working tasks, previously completed by hand, are now solved on an automatic regime with the use of "smart contracts" (Bank of Russia, 2017c).

Progressive financial institutions are already investing a lot in blockchain. The general financing of venture capital connected with blockchain exceeds one billion dollars, and the general volume of comment investments in the given technology is reaching three billion dollars. The volume of blockchain investment has reaching 2.4 billion dollars, which exceeds the indicator of last year by 340%. It should

be noted that 25% of the volume of all investments in blockchain-startup are attracted through venture stock, and 75% through the mechanism of primary coin deals (ICO). Among leading countries in the blockchain industry the greatest volume of investment, come from the United States, followed by the United Kingdom, Ireland, Singapore, and China.

At the current moment, there exist several venture capital funds. The most prosperous in terms of capital raised among bitcoin and blockchain firms, according to news and research site Coindesk, are the followings:

1. Circle Internet Financial ($136 million) ;
2. 21 Inc. ($121 million) ;
3. Coinbase ($116 million);
4. Ripple ($93 million) (MaketWatch, 2016).

Digital Currency Group and Blockchain Capital are the two most active investors in the sector, specializing in digital currency markets.

In accordance with analysts' data, Blockchain Capital invested in total around 445 million dollars, Digital Currency group – 413.2 million dollars.

1 BACKGROUND

The study of the effects of new technologies actively used in financial markets is a traditional topic of economic research. The economic phenomenon of the blockchain technology is explored from various perspectives. In particular, some authors regard the blockchain technology as a tool for establishing a new world economic order. Thus, Satoshi Nakamoto proposed a "system for electronic transactions without relying on trust". Under these conditions, online payments are sent "directly from one party to another without going through a financial institution" (Nakamoto, 2008). Skinner Chris investigates how fintech firms are building the Internet of Value (the ValueWeb) using a convergence of the bitcoin blockchain, e-commerce and technologies from mobile devices and wearables, and what does that mean for citizens, financial institutions and governments (Skinner, 2016). Swan Melanie considers that the blockchain may become the fifth disruptive computing paradigm after mainframes and personal computers, the Internet and mobile networks (Swan, 2016). According to Paul Vigna and Michael J. Casey, cryptocurrency will lead to a complete rethinking of the place and role of traditional financial and social structures in the economy, creating a new financial system without intermediaries, will enable the inclusion of billions of people in the new economy (Vigna, 2015).

The legal framework of the blockchain technology application is being actively studied (Bank of Russia, 2017b; Bank of Russia, 2017c). The geo-financial risks of the blockchain technology application, including unregulated application () and changes in the global and local competitiveness of countries, markets, and institutions () are studied. The possibilities of the blockchain technology for manufacturers and service providers and consumers () and the practice of its using by individual financial institutions () are analyzed. There are comparative studies of various types of distributed registries technology' effectiveness (). Some researchers, including Wattenhofer Roger, believe that the blockchain science has been formed (Wattenhofer Roger, 2016). We have showed only the main directions of the existing economic research on the use of blockchain technology.

2 FOCUS OF THE CHAPTER

The purpose of this study is to identify the main challenges of using blockchain technology in financial markets in Russia. Undeveloped legislation regulating digital instruments requires the identification of risks associated with the use of distributed ledgers in the financial institutions' activities.

To achieve this goal, the following tasks were solved:

- The main risk factors emerged in the application of distributed ledger technology for the creation of innovative financial instruments were identified;
- The state of Russian financial market was studied; the need to solve legislative and economic problems in the process of digitalization of banking services was confirmed;
- The analysis of the state of credit institutions' legal regulation for the use of blockchain applications was carried out;
- Prospective directions of risk management in banking institutions for the implementation of blockchain technology in the Russian financial markets were proposed;
- The most relevant practices of financial institutions in the use of blockchain technology were identified.

The focus of the chapter is economic and legal aspects of using blockchain technology in financial markets.

The global practice of application of distributed ledger technology was supported by the development of the legal rationale for the use of this technology in various spheres. Legislative initiatives to recognize digital assets and create an appropriate legal framework for their operation have passed through various stages, from the formation of the most favorable environment (sandboxing method) to the complete rejection of such innovations in the financial sector due to the impossibility of their centralized control. The sandboxing approach does not imply mandatory regulation by general laws on the use of distributed ledgers, but rather relies on the creation of an isolated, controlled technological environment based on blockchain technology. This is the path taken by the authorities in the United Kingdom, Switzerland, and Australia. Singapore has also created a favorable environment. Other countries in the Asian region remain wary of this technology, assessing the risks posed as outweighing the benefits of blockchain technology. The reasons for these assessments are real and have been confirmed by the active use of cryptocurrencies in ML/FT financial transactions.

The Russian legal practice of regulating the use of digital financial assets is in its infancy. In 2019, amendments were made to the Civil Code of the Russian Federation, which introduced a basic definition of "digital rights". The content and conditions for the implementation of such rights are determined in accordance with the rules of an information system where such rights exist (Federal Law of 18 March 2019 No. 34-FZ,). Since the beginning of 2021, Federal Law 259 "On Digital Financial Assets" came into force (Federal Law of 31 July 2020 No. 259-FZ,). The law regulates the relations arising when digital financial assets are issued, registered and circulated, the peculiarities of the operator's activity within the information system where these DFA are issued, as well as the relations arising from digital currency turnover in the Russian Federation. The legal ground for the recognition of DFA, and, consequently, cryptocurrency as property has been created. This allows bringing blockchain-based instruments out of the «gray zone» and applying in practice consideration of DFA as an object of bankruptcy proceedings

or inheritance. The Bank of Russia is responsible for regulating DFA turnover, which makes it difficult to take advantage of non-centralized activities in the financial markets.

The creation of the legal framework for the use of blockchain technology in Russia would allow to solve numerous economic problems associated with the DFA accounting. Such challenges include formation of a basis for taxation of transactions or existing property, use of blockchain technologies as a competition tool for the SWIFT international interbank system (prospects of sanctions restrictions), use of DFA as a bank loan collateral.

There is an opportunity for Russian companies to supply the market with tokenized products: raw materials, consumer goods, various services, real estate objects, art objects. Domestic businesses can issue stablecoins, i.e. cryptocurrencies with a built-in stabilization mechanism designed to minimize price volatility. Tether (USDT), equal to one U.S. dollar, is an example of the largest stablecoin. It is traded actively on public cryptocurrency markets, and its rate has been generally stable for three years.

3 RISK-FORMING FACTORS AND ACTUAL RISKS OF THE USE OF DISTRIBUTED LEDGER TECHNOLOGY

Functioning of the various distributed ledger systems in various segments of the financial market generates various risks profiles of the users of these technologies, thus it may demand the differentiated approaches to their regulation.

In financial market, the widest distribution has been won by the closed and hybrid networks, whereas they allow creating the mechanism of network management, to limit access to a network and to control the actions of the participants, all those are demanded to implement numerous transactions and operations (figure 1).

The networks were typified based on an assessment of external access and network management capability. In open networks of distributed registries there are no access restrictions for participants, everyone has the opportunity to join the system, read or write information into it. Person in an open network is not identified (i.e. anonymity or pseudo-anonymity is ensured). No nodes that dictate the rules of the network and have control over it. An example of an open network is Bitcoin, the Peer-to-Peer cryptocurrency network.

Closed networks have conditions, under which participants are allowed to join the network, to gain access to the management of its nodes. These conditions could be financial or legal requirements. In this type of network, all members are identified, access to the network is restricted and regulated, and there is a responsible node managing the network with exclusive rights. Regardless of whether a network is open or closed, participants may have different roles and functions (processing new assets, confirming transactions, etc.). Some participants may only have access to view the register, while others are allowed to make entries into the register. Registries of transaction records and tenure statuses are usually maintained as a common registry that is trusted by all participants.

Hybrid distributed registry networks combine the properties of open and closed networks.

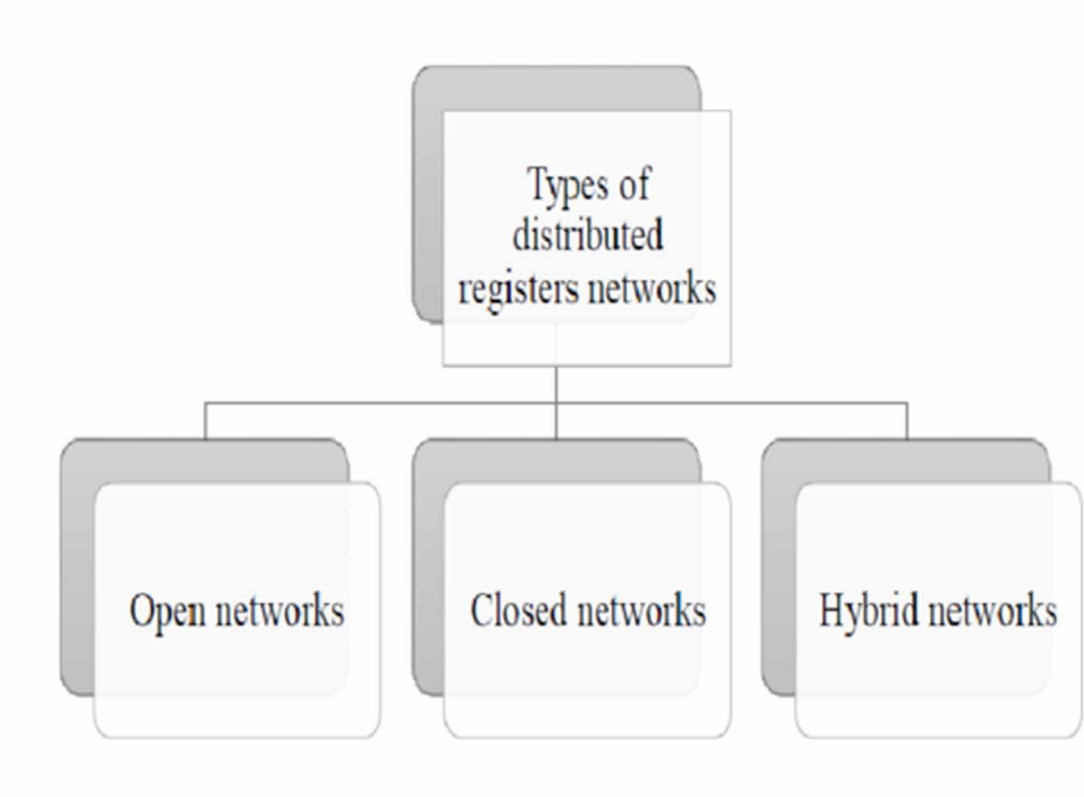
Since closed and hybrid networks have management mechanisms, restrict access, control participants, and supervise their actions, they have the highest potential for application in the financial markets.

The distributed ledger technologies have led to the qualitative leap in the development of:

- payments,

- clearing,
- settlements,
- systems of assets service and storage, etc.

Figure 1. Types of distributed ledger networks



However, alongside with huge positive potential, the system of risk-forming factors and actual risks is being formed.

Modern classification of the distributed ledger networks, in the most general view, is based presently on the following criteria (figure 2):

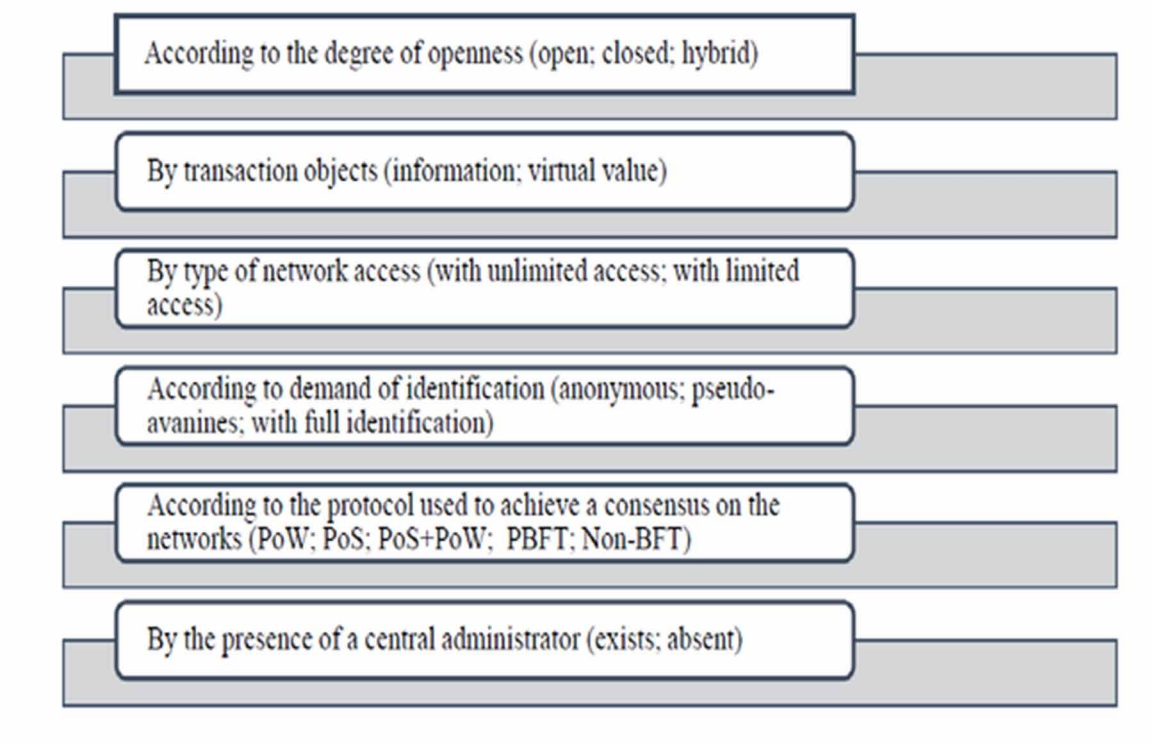
Information and virtual values (e.g., cryptocurrency) can be the objects of transactions in a distributed ledger network.

The type of access also classifies networks. In a network with unrestricted access, participants are allowed to carry out any activity, in a network with restricted access only certain types of it.

According to the protocol used to achieve a consensus network distinguish: PoW (Proof-of-work) - the right to validate a block is given to a participant based on his performance of some sufficiently complex computational task (the largest work produced), provided that it is possible to verify the result quickly and easily. In fact, nodes are competing in processing capacity and are constantly operating at critical loads, expending electrical energy both to provide computation and to remove excess thermal energy and to cool. PoS (Proof-of-stake) - the right to validate a block is given to an account holder when

the amount of his funds and term of their possession correspond to the specified criteria. The hybrid PoS/PoW consensus algorithm allows both Proof of Stake and Proof of Work procedures to be used simultaneously to achieve consensus. The purpose of this approach is to complicate the recalculation of the entire chain (from the very first block) possible when using PoS alone. PBFT (Practical Byzantine Fault Tolerance), Paxos, RAFT - algorithms of multistage network consensus establishment (resistant to "Byzantine behavior"). Algorithms of this group allow Peer-to-Peer networks to function with low expenses and have a considerable capacity, but they are weakly stable to the increase of amount of participants. Non-BFT (Non Byzantine Fault Tolerance) - consensus algorithms, unstable to the behavior in which part of participants starts to work against the network. Such algorithms are applicable in closed networks with full identification.

Figure 2. Criteria for the classification of distributed ledger networks [Compiled by the authors based on (Bank of Russia, 2017a)]



Let us note that not all networks of distributed ledger function on the blockchain basis. For example, the Ripple platform intended generally for the implementing of bank-to-bank payments means step-by-step transactions processing without formation of blocks (Bank of Russia, 2017b). I.e., in banking business there are the technologies implementing the distributed ledger of both block and non-block type, which, certainly, forms various risk profiles of bank activity and, probably, demands the accounting in both the regulation and the supervision.

The use of distributed ledger technology creates the risks of destabilization of legal regulation of bank business. It was provoked by the appearance and use of new digital financial assets (tokens and cryptocurrencies). The destructive effect of those risks measured in possible losses depends directly on whether the adequate digital legislation, the subordinate regulatory base has been developed or failed to be developed and how successful the law-enforcement practice proved to be in this regard.

4 RUSSIAN FINANCIAL MARKET CONDITIONS

The importance of the problem of the financial market legal regulation is defined among other reasons by the parameters of its development (refer to table 1). The results of the available researches devoted to this subject differ in details only; the main constituent characteristics of the Russian financial market development do not contradict each other.

Table 1. Elements of the financial market development factor of the Global Competitiveness Index of Russia (GCI) in 2017-2018 [Compiled by the authors based on (World Economic Forum, 2018)]

Item number	Elements (components) of the Financial Market Development Factor of the Russian Global Competitiveness Index in 2017-2018	Rank	Value
1	Legal Rights Index	49	6
2	Venture capital availability	89	2.6
3	Financing through local financial market	90	3.1
4	Affordability of financial services	94	3.4
5	Availability of financial services	101	3.7
6	Ease of access to loans	110	3.2
7	Regulation of securities exchanges	112	3.5
8	Soundness of banks	121	3.6

107 – that is the rating of Russia measured by the «Financial market development» factor in the GCI rating in 2017-2018 with the score 3.4 out of 7 possible (World Economic Forum, 2018) (refer to table 2).

At the same time, the fact of insufficient development of the financial market compared with the universal tendency of high development rates, especially in the segment of the blockchain technology used by the financial organizations, cannot be considered as the basis for preservation and/or expansion of a zone of a non-regulated use of this technology, whereas some forms of this its use can infringe national economic interests.

Table 2. The position of Russia and several countries according to the factor "Development of the Financial Market" in the 2017-18 GCI Rating [Compiled by the authors based on (World Economic Forum, 2018)]

Nº	The Position of Russia and Several Countries According to the Factor "Development of the Financial Market" in the 2017-18 GCI Rating.	Country	Points
1.	1.	New Zealand	5,8
…	…	…	…
2.	107	Russia	3,4
…	…	…	…
3.	137	Mauritania	2,1

Russia's financial market model in many ways has much in common with models of other countries' developing markets (Indonesia, Argentina, Columbia, Kazakhstan, Turkey, Peru, Uruguay, Macedonia, the Philippines, Pakistan, Mexico, and a host of other countries). Its basic features are the dominance of banks over Noncredit Financial Organizations (NFOs), support of economic agents when investing on their own means, and the advantageous role of budget and intercompany channels in redistribution of financial resources in comparison with the channel of financial mediation.

At the end of 2017 Russian credit organizations' assets comprised 92.6% of GDP; assets of the three foundational groups (NFOs, NPF), of insurance case subjects and Mutual Fund NAV, 4.0%, 2.5%, and 3.2% from GDP, respectively. However, it slowed down due to the limitation of access to external capital markets in consequence of financial-economic sanctions imposed on Russia by neighboring countries. (Bank of Russia, 2018). The weak development of the capital market and the lack of a solid foundation of institutional investors in the face of insurance companies and pension funds limit the ability of the economy to transform people's savings into long-term investments necessary for sustainable economic growth and improving the welfare of citizens. The influx of foreign investment in recent years is significant.

The Russian financial market has other features. These include high level of concentration in certain sectors, like in the banking sector, where 55.8% of the total assets of the entire sector account for the five largest credit institutions. In terms of concentration, the Russian banking sector is in the middle of the list of countries in the EU, and much closer to countries with low levels of concentration. In 16 EU countries, the share of the five largest banks is higher particularly in Greece (97.3%), Estonia (88.0%) and Lithuania (87.1%) In addition, in nine EU countries, the concentration is lower: in Luxembourg (27.6%), Germany (31.4%), and Austria (34.5%). In Russia, people are less active in the financial market, but for saving money often using the Bank deposits. It is due to measures that take Russian Bank to strengthen the reliability of the banking system (including the stability of the deposit insurance system) and the historically low confidence in non-bank financial intermediaries because of the shady and unfair market participants. At the end of 2017, the volume of household deposits in Russian banks amounted to 26 trillion rubles. (28.2% of GDP).

The level of citizens' confidence in financial organizations is extremely heterogeneous, but 26% of citizens consider credit default acceptable, and 38% believe that a slight delay in making payments on the loan is not terrible. Obviously, this is a consequence not so much of the low ethical level of Russian borrowers, as of their low financial awareness (for example, lack of understanding of the significance of

credit history). The latter is confirmed by a study of financial literacy, conducted in 2016 by the Organization for Economic Cooperation and Development in 26 countries, where Russia was in the 23rd place.

In spite of a set of measures to improve the stability of financial institutions, the process of cleansing the Russian financial market has not been completed. In recent years, the Russian financial market has gone through many regulatory changes. These innovations, despite their importance and positive impact on the long-term development adjust operational processes and create a number of inconveniences for the financial companies. In addition, frequent changes in the rules may adversely affect the public's understanding of the changes that are taking place and, as a result, on citizens' confidence to the whole market.

Technological innovations in the financial industry is a major global phenomenon in recent years, and the pace is accelerating every year.

"FINTECH" (abbreviation of the "Financial Technologies") became the new industry in the financial markets to improve the current financial system. According to various estimates, there are already about 10 thousand FINTECH startups in the world, and their number is constantly growing. From 2010 to 2015, the volume of venture capital investments in Fintech increased 10 times, almost to $ 20 billion a year. Startups grow into the largest companies, whose value is estimated at tens of billions of dollars.

The quantity of services provided with the use of financial technologies in Russia is still extremely small compared to the size of traditional forms of financial transactions, but has a significant growth rate. In the future, the development of legislation can give FINTECH companies every chance to turn from innovative laboratories into aggressive competitors to classic banks and even press their positions in the market, as has happened, for example, in the UK and Singapore.

According to experts, in Russia, 95% of all FINTECH operations are concentrated in banks and other professional financial market participants. Leader in the implementation of financial technologies is Russia's largest bank, Sberbank. In addition, such banks as Alfa-Bank, Tinkoff, Otkritie and Promsvyazbank have achieved significant results in this direction. Technologies are aimed for increasing the level of customer comfort.

The expert community does not have a single point of view on how the financial technology market will develop in Russia in the next 5–10 years. On the one hand, traditional banks have structural advantages: financial resources, economies of scale and access to a vast client base. Under these conditions, FINTECH companies will most likely become the "digital hand" of traditional banks — external departments and sources of innovative technological solutions, ideas and data. Therefore, the small credit organizations will be able to gain access to innovations, thereby increasing their competitiveness, and FINTECH companies will be able to secure the necessary financing and maintain their place in the market, occupying its niche segments. Perhaps, if digital transformation and interaction with leading IT companies will proceed at an accelerated pace, the largest banks will succeed more quickly than FINTECH companies to enter market segments that are still poorly covered by traditional financial institutions, for example, the high-risk segment of retail borrowers. On the other hand, if the regulatory and infrastructural environment begins to transform at an accelerated pace, the role of FINTECH companies may become more significant. Removing barriers to the development of financial technologies (including the opening of banking APIs and the ability to identify customers without their personal presence), together with the creation of a "regulatory sandbox", will lead to a redistribution of the market in favor of new players. In this scenario, traditional banks risk turning into a sectoral infrastructure — something like reinsurance companies in the insurance market. In turn, high-tech innovative companies close to customers and transactions, such as payment systems (Visa, MasterCard), providers of mobile payment

systems (Apple Pay, Google Pay); financial services aggregators (Simple) will become masters of client preferences (McKinsey & CIS Company, 2017).

5 LEGAL PROBLEMS OF USING BLOCKCHAIN TECHNOLOGY IN THE FINANCIAL MARKET

The most valuable experience in the field of assessment of legal risk in relation to Russian participants of the financial market has been accumulated by the commercial banks.

Legal risk is the risk associated with a credit institution's losses due to a number of internal and external risk-forming factors, namely:

- Non-observance by a credit institution of the legislation of the Russian Federation, including the identification and study of clients, the establishment and identification of beneficiaries (persons for whose benefit clients act) of constituent and internal documents of the credit institution;
- inconsistency of the internal documents of the credit organization with the legislation of the Russian Federation, as well as the inability of the credit organization to bring its activities and internal documents in a timely manner in accordance with changes in legislation;
- ineffective organization of legal work, leading to legal errors in the activities of a credit institution as a result of actions of employees or governing bodies of the credit organization;
- violation by a credit institution of the terms of contracts;
- insufficient development by the credit organization of legal issues in the development and introduction of new technologies and conditions for conducting banking operations and other transactions, financial innovations and technologies;
- imperfection of the legal system (lack of sufficient legal regulation, inconsistency of the legislation of the Russian Federation, its susceptibility to changes, including in the imperfection of methods of state regulation and (or) supervision, incorrect application of the legislation of a foreign state and (or) international law), the impossibility of solving individual issues through negotiations and, as a result, the application of the credit organization to the judicial authorities for their settlement;
- violations by clients and counterparties of the credit organization of the terms of contracts;
- location of a credit institution, its branches, subsidiaries and affiliates, customers and counterparties under the jurisdiction of different states.

It should be noted that the financial organizations around the world including Russian ones, has come up to a situation of legal uncertainty. Digital legislations of the countries are only being formed and they differ inevitably, demonstrating their almost absolute incompatibility and different interpretation of basic legal concepts.

Introduction of the project decisions based on the blockchain technology in the financial markets goes on spontaneously; it is not followed in the great extent by any explanatory comments of legislators and regulators.

Table 3. New blockchain applications in the field of financial services and non-financial services related to the financial sector [Compiled by the authors on the basis of (PwC Global Power & Utilities, 2018)

Item number	Synopsis blokchain applications in the field of financial services	Examples of blockchain applications	Item number	Synopsis blokchain applications in the field of non-financial services related to the financial sector	Relatively new blokchain applications
1.	Trading in digital securities. Confirmation of shares and transfer of rights to property	equityBits, Spritzle, Secure Assets, Coins-e, DXMarkets, Muna, Kraken, BitShares	1.	Digital identity. Protection of personal information of consumers.	Sho Card, Uniquid, Onename, Trustatorm
2.	Exchange rate differences	Coinbase (Wallet), BitPesa, Billion, Ripple, Stellar, Kraken, Fundrs.org, MeXBT, CryptoSigma	2.	Rights Property confirmation. Authentication and authorization.	The Real McCoy, Degree of Trust, Everpass, BlockVerify
3.	Data storage	Storj.io, Peemova	3.	Checks / Recommendations Validation of ratings and checks credibility	TRST.im, Asimov (recruitment services), The World Table
4.	Transactions between peer members of the network (P2P) Verification of network members	BTC Jam, Codius, BitBond, BitnPlay (пожертвования), DeBuNe (transaction B2B in the SME segment)	4.	Gems / Gold / Silver	gems: Everledger; Gold and silver: BitShares, Real Asset Co., DigitalTangible (Serica), Bit Reserve
5.	Digital Content of Storage and Delivery	BotProof, Blockcai, Ascribe, ArtPlus, Chainy.Link, Stampery, Blocktech (Alexandria), Bisantyum, Blockparti, The Rudimental, BlockCDN	5.	Infrastructure networks	Ethereum, Eris, Codius, NXT, Namecoin, ColoredCoins, Hello lock, Counterparty, Mastercoin, Corona, Chromaway, BlockCypher

We believe it is important to consider the particular features of use of the models with the public and private chains of blocks. It is important for all process of risks management, including the legal ones, and for regulations.

Table 4. Public and private blockchain properties

Item number	Public Blockchain	Item number	Private Blockchain
1.	A reliable agent is no longer needed.	1.	The operator can control who gets access
2.	Operator cannot manipulate data.	2.	Interventions are possible (after the data is reflected in the system)
3.	There is no incentive to charge additional fees	3.	Too much anonymity is possible.
		4.	Lower operating costs
		5.	Fast process of transaction

Banks have to deal already with the smart contracts based on both public and private chains of blocks (refer to table 5 to compare public and private block chains).

Table 5. Comparison of public and private block chains

Comparison criteria	Public blockchain (the case of Etherium)	Private blockchain (the case of R3)
Registration	Anonymous Free access	Invitation-based Know-your-customer controls
Smart contract preparation	Public structure enables wide variety of applications Users can trade with all users	Contracts are made between customers through operator's platform
Blockchain	Decentralized data storage & verification performed by P2P network	Centralized data storage & verification performed by operator
Manipulation	No ex-post revisions possible	Ex-post revisions possible(e.g. in the case of legal dispute)
Costs and fees	Higher operating costs No operator fees	Lower operating costs Operator fees

Thus, there are two fundamental and significantly different trends in the development of blockchain solutions with integrated functionality of smart contracts.

6 RISK MANAGEMENT IN THE BANKING SECTOR AND THE CHOICE OF BLOCKCHAIN MODEL

The question of the choice of a blockchain model that will be applied in the bank sphere should be accompanied by the solution of another question, i.e., the choice of risk management methods, including the legal ones, and the ways of legal regulation of this business.

In the Russian Federation the Masterchain platform is being developed with participation of the *Fintech Association,* this is a universal common platform for the financial information exchange and storage basing on the distributed ledger technology. This platform will make it possible for the financial market participants to create and bring innovative financial services to the market.

Blockchain Models

Anyway, Russian banks will be involved in the following scenarios using blokchain technology:

1. *Depository accounting of electronic mortgages.* This scenario establish an ecosystem solution for all participants in mortgage operations (banks, AHML, depositories, Federal Service for State Registration, Cadastre and Cartography) and will automate the processes of issuance, accounting and operations with electronic mortgages, which will further ensure the transfer of mortgages into electronic form. In addition, digitalization of transactions in mortgages and unification of operations will significantly reduce the costs of registering mortgages, compiling and maintaining mortgage registries during securitization.
2. *Digital bank guarantees.* This scenario involves the creation of a decentralized register of bank guarantees to reduce labor costs and costs of technological infrastructure in the process of issuing, receiving and checking bank guarantees for all participants in the chain and their digitalization. The direct participants in the system will be all banks operating in the territory of the Russian Federation. In addition, the system will provide read access to other users: individuals, legal entities and government bodies. The distributed ledger is supposed to keep records and monitor the status of bank guarantees. Using a distributed ledger will help reduce costs and speed up the process of issuing bank guarantees, simplify the process of checking them by third parties, and ensure access to them.
3. *Digital credit*. This scenario involves the creation of solutions based on the technology of distributed ledgers to conduct transactions on letters of credit with a view to reduce the time of the transactions and eliminate paper workflow. All participants in letters of credit transactions will be connected to the system, and the main stages of the fulfillment of obligations under such transactions will be recorded in it. The expected result from the implementation of the scenario is a reduction in the duration of transactions with a letter of credit with a coverage of 15 days.
4. *Financial messaging system using distributed ledger technology* should ensure the transfer of financial messages directly from the sender to the recipient bypassing financial intermediaries. The system will also monitor financial messages, identify the sender and recipient, maintain a list of counterparties, control and monitor functions, maintain archives of incoming financial messages.

Risk Management Methods

International monetary and credit institutes, diplomatic institutes of different kinds demonstrate their understanding of the importance of a policy and actions which accelerate digital transformations, including those based on the blockchain technologies and, at the same time, they are concerned with the new blockchain-associated risks that are either insufficiently investigated or not investigated at all (G20, 2018). Here the legal risk depends too much on the primary risks of bank business connected with the use of new technologies.

The regulatory platform (Sandbox) developed by the Bank of Russia for an approbation of innovative technologies, products and services, provides rather fast verification of a positive effect from the introduction of innovative technologies and services intended for both the financial market and the consumers, it provides the risk analysis and simulation of threats caused by these technologies as well (Bank of Russia, 2017c).

The regulatory platform let to explore innovative financial technologies and services when piloting them in the form of "testing" or in the form of a "limited regulatory experiment". Many foreign financial regulators, including the Financial Conduct Authority (UK), the Monetary Authority of Singapore (Singapore) and the Australian Securities and Investment Commission (Australia) already use this mechanism. Such sites allow financial and other organizations to pilot innovative financial technologies and services, providing them to customers in a limited perimeter under the control of the regulator. At the same time, limited use or complete exemption from the current requirements of the regulator may be envisaged for piloting participants and (or) new requirements are introduced. Pilot projects affect not only the distributed ledger technology but also the biometric technologies, cryptotechnologies, technology of artificial intelligence, open interfaces, crowd funding and others.

For example, the regulatory platform of the Financial Conduct Authority (Great Britain) has already recruited three groups of companies for piloting financial technologies and services and is recruiting a fourth group. Participants of the first group (18 companies) completed piloting. Twenty-four companies took part in the second group. In the third - 18 companies, among which:

Chynge - the international money transfer system based on distributed ledger technology, which includes a transaction monitoring system (based on artificial intelligence) in order to more effectively counter money laundering and financing of terrorism, as well as fraud;

Etherisc - air travel insurance using smart contracts and blockchain technology;

Resonance X is a new electronic platform that provides end-to-end automation of pricing, execution and product lifecycle management processes using centralized or distributed (blockchain) asset accounting;

Solidi is a blockchain-based payment platform that uses cryptocurrencies to make money transfers at a higher speed and with lower transaction costs (Bank of Russia, 2017a).

This practice can protect consumers of financial services from risks and it is essential to reduce the level of legal risk for the innovators.

At the same time, the problem of the different business behavior modes in the field that was occupied once by banks only is extremely important. I.e. the credit institutions are under the strict observation and control yet, whereas some other participants in this business segment remain «neglected» but they get profit, generate the increased risks, distort the competitive relations, they can at any time discredit the business of other participants of the financial market and in general, generate the increased legal risks.

The study of theoretical and legal sources, the synthesis and systematization of world and domestic experience allowed us to assume that it is legitimate to single out the risk groups of the parties most actively involved or governing the processes of the emerging legal and illegal crypto economics (Amosova et al., 2018).

It seems appropriate to talk about the risks of money laundering and tools based on the blockchain technology for:

- Individuals;
- Financial institutions;
- Regulators;
- Law enforcement agencies responsible for anti-money laundering / financing of terrorism (AML/FT);
- civil society.

For individuals. Cryptocurrency and other derivatives of the blockchain, in accordance with the current Russian legislation, are not subject to civil rights, which means that they themselves cannot be the subject of criminal infringement in the form of fraud, extortion, theft, etc. In this sense, at present, in the Russian Federation, due to the lack of digital legislation, the legal risks associated with the inability to protect bona fide ones by law are concentrated:

- Cryptocurrency owners (that is, those who already owns cryptocurrency and other derivatives blokchain technology (Digital Asset));
- Willing to become owners of cryptocurrency (that is, potential owners who are ready to part with the legitimate currency in exchange for cryptocurrency);
- Willing to get rid of cryptocurrency (through a legal entity?), which they own (for speculative or other purposes).

In addition, the only thing that ensures the security and access of the owner to his e-wallet is a private key, in case of loss of which funds are lost forever.

Online P2P lending platform promises investors high returns. However, the experience of the Chinese market shows that omissions in the field of government regulation can lead to fraudulent schemes and massive bankruptcies of P2P companies. A striking example is one of the largest P2P platforms in China, Ezubao, which, according to the Chinese authorities, deceived more than 900 thousand of its investors, causing damage totaling about 5.8 billion US dollars. This risk is also relevant for Russia, where certain categories of citizens who are not well versed in the particularities of the financial market may invest in "financial pyramids" and other dubious financial schemes.

For financial institutions. Due to delays in the development of digital legislation, clusters of financial institution risks are formed, aggravating the current situation. In particular, the probability of the following risks increases: deep involvement in AML / CFT; lack of relevant internal regulatory framework in the field of AML / CFT; lack of time to adjust the training of personnel capable of resisting attempts at AML / CFT; significant time lag in software updates; delayed engagement in the processing of smart contracts with proper protection, etc.

For regulators. If we talk about the Bank of Russia, then it generates a legal risk of forming a lagging and relatively low-tech supervision of the activities of financial institutions in terms of AML / CFT. In addition, there is a real threat to the implementation of legal risk not to ensure timely coordination of actions and the adequacy of the current and future objectives of the entire regulatory framework governing the activities of financial organizations in the field of AML / CFT.

For law enforcement agencies responsible for anti-money laundering / combating the financing of terrorism (AML / CFT). The legal risk of legalization is fueled by the inability to coordinate their actions with colleagues from abroad and from international organizations, since some legal norms are absent in Russian legislation. The legal risk of inefficient and unsatisfactory work is increasing due to the preservation of unregulated crypto-economic zones. The legal risk of legalizing funds and tools based on the blockchain technology can be realized in the form of an increase in the period when it is impossible to stop illegal activities due to the impossibility of proving the existence of a crime in accordance with current legislation. Widely discussed Article 128 of Civil Code of the Russian Federation and Art. 174 and 174.1 of the Criminal Code remain the most problematic.

Risk for civil society. Unformed digital legislation, including AML / CFT, creates a legal risk of losing control over economic processes in the economy. The risk of an irreversible lag behind the world

leaders in terms of using the positive possibilities of using blockade technology because of the high criminalization and discrediting of the country segment of crypto economics seems real.

In the context of risk analysis of the use of blockchain technologies in financial markets, one cannot help raising the problem of digital unemployment. In a broad sense, the key feature of the blockchain is the elimination of the human factor - mathematics and computers, which are much more reliable, are responsible for the reliability of operations.

In January 2017, Sberbank President German Gref said at the Davos forum that, due to digitalization of services, by 2025 the total staff number of Sberbank could fall by half. "Now we have 330 thousand employees, but in 2025, I think we will have half of them." Later, in July 2017, Gref said that modern companies do not need lawyers without knowledge in the field of artificial intelligence and an understanding of modern computer technologies. According to him, Sberbank ceases to hire lawyers, "who do not know what to do with the neural network."

Other banks are replacing workers with robots in addition to Sberbank. Therefore, in July, VTB Bank announced the start of testing a robot collector to work with overdue debts of individuals in the early stages. Deputy Chairman of the Board of the Bank Anatoly Pechatnikov noted that robots show the best performance in collecting debts than bank employees, and the cost of maintaining it is much lower. He said, "The robot is always in a good mood, not subject to emotional shocks that can affect the quality of work. Plus, he always fulfills quality standards".

Therefore, according to a McKinsey study, by 2030, 800 million people will lose their jobs. As German Gref noted, this is four times the number of unemployed now. However, simultaneously with the reduction of people, new jobs will be created. In particular, by 2030 we are talking about creating 890 million new jobs. "This is about the question of how powerful the infrastructure of preparing society for this transformation should be," said German Gref.

Specialists from Capgemini, one of the world's largest management and information technology consulting companies, claim that robots are 50–90% cheaper than using full-time and freelance employees and banks will invest more and more in artificial intelligence in an attempt to increase their efficiency while maintaining high quality customer service. Artificial intelligence will help banks automate processes and improve customer service. According to a study by Diebold and Forrester, 47% of banks' operating expenses go to maintain the network, 54% of which is personnel costs. Therefore, most banks around the world are closing offices, looking for new forms of their continued existence and ways to optimize costs. The use of modern financial technologies by banks will allow them to minimize their costs, increase the speed of service to real-time, provide an individual approach to serving their customers, achieve round-the-clock banking services and, consequently, reduce tariffs. As the experience of foreign countries shows, the digitalization of key processes in a traditional bank, whether it be sales of new products or after-sales service in branches, reduces their cost by 40–60%.

7 BEST PRACTICES OF FINANCIAL INSTITUTIONS IN USING BLOCKCHAIN SYSTEMS

The Chain of Corda Blocks

According to many experts (PwC Global Power & Utilities, 2018), the main innovator in this sphere is the consortium of 45 big international banks financing the R3 startup process. They are Barclays, BBVA,

Credit Suisse, JPMorgan, Royal Bank of Scotland, Deutsche Bank and UBS. These Banks cooperate in the R3 since 2015 in the scope of utilizing the blockchain technology as a supplementary to «real» currencies, e.g., Euro or US dollar. A main goal of this cooperation is the development of common industry standards allowing the most differing banks to use blockchain systems. In March 2016, R3 applied successfully for the first time its own blockchain system named Corda for bonds tendering within the pilot project in which 40 banks took part.

The chain of Corda blocks, similar to practically any other private block chains, has some properties, useful primarily for banks, e.g., it allows the banks to use a transaction platform and at the same time to acquire the exclusive right to access data.

Special attention within this project is paid to an integration of «smart contracts». In April 2016 the Barclays – actually the heavyweight champion of the British bank business, sector had shown for the first time how the chain of Corda blocks could be combined with «smart contracts» in the trade of derivative financial instruments.

The private blockchain systems may protect the market share, that is, to solve a certain list of tasks of a bank which form the set of legal risks both in case of their regulation, and in case of a failure to develop this regulation in time.

Eutherium

Speaking about smart contracts based on public blockchain, the leading position is occupied by the *Etherium*, which cooperates with Microsoft, Samsung and RWE. With Etherium, one can build a uniform automated international payment service. Such development will very favorably affect the consumers for it will be able to provide an almost free alternative to the private block chains being created now in the financial sector. However, the incidents are possible even here, in this structure: in June 2016, it was revealed that some user stole 3.6 million *ethers* from the DAO investment fund, which is equal to 50 million US dollars. Comparing the *Etherium* and R3 indicates the existence of two fundamentally and significantly differing tendencies, which are well observed in the development of the blockchain-solutions with an integrated «smart contracts» functionality (PwC Global Power & Utilities, 2018).

Sberbank projects based on blockchain technologies

As for Russian banks, from 2014 to 2017, Sberbank launched about 15 different pilot projects related to the blockchain technology. Some of them went into commercial operation, and the bank began to benefit from it. A representative of the Sberbank Innovation Center noted that Sberbank is not trying to apply blockchain technology everywhere. It use the technology when openness and transparency, peer-to-peer (P2P) services, documentation and the ability to prove the immutability of information, etc. are required. One of the most interesting projects of Sberbank is the use of blockchain in an eskroa, which gives guarantees, for example, when buying an apartment or buying online, that all transactions will be carried out by participants simultaneously.

Successful projects with the blockchain at Sberbank are not related to financial services. One of them is the distributed document flow, which has already been tested with a number of counterparties. The blockchain-based platform allows you to exchange documents in encrypted form using distributed registry technology. Documents are stored in a local instance of the distributed database and replicated

by standard mechanisms. Operations with documents are marked in the blockchain, and data about operations are replicated by standard means of the software on which it is built.

In mid-October 2016, Sberbank and the Russian Federal Anti-Monopoly Service launched a pilot project for exchanging documents based on blockchain technology of the Digital Ecosystem. The goal of the project is to explore the possibilities of distributed storage of documents that can increase the speed, reliability and quality of interaction during their exchange. With this model, documents can be transferred and stored in encrypted form, as well as using an electronic signature. The innovativeness of the Digital Ecosystem project is that the workflow does not use communication operators. Convenience solutions and cost savings are achieved using networks of participants. The project involved the company "Aeroflot", "Russian Coal", "ForteInvest". Sberbank Factoring and M.Video are implementing another soaring project. In their interaction, there was the problem of reconciliation of documents on deliveries (this is a long process that includes many reconciliations, confirmations, etc.). No matter how they tried to optimize and speed up this process before, the effect was insignificant.

As part of a pilot project, companies tested the delivery registry of supplies, data encryption (hashing), their subsequent verification and storage using blockchain technology. Deliveries that are loaded into the M.Video system are encrypted and reconciled with Sberbank Factoring data for subsequent financing of suppliers. The human factor is excluded from the delivery confirmation process - the reconciliation of commercial information takes place automatically. The platform compares the cached delivery data: if they are the same for both participants, the delivery is confirmed. Such an approach allowed speeding up the reconciliation process, reducing financial risks for the factoring agent and eliminating the risk of leakage of commercially important data.

Among the working projects is also the exchange of information about fraudsters between banks. As of mid-2017, several banks and some telecom operators were included in the exchange of data on fraudsters using the blockchain. The security services of banks enjoy this enthusiastically. Among the solutions, that Sberbank uses to create a blockchain is the Ripple platform, which has its own protocol and open source protocol. At the same time, Sberbank is more inclined to use open solutions (Tadviser, 2017).

Use of Blockchain by VTB Bank

In 2018, VTB patented the technology for creating multi-issuing settlement and payment systems on the blockchain. The technology will allow VTB to create digital products, services, and payment instruments, solving the problem of accounting for settlements between an almost unlimited numbers of system participants. Potential users can be both individuals and legal entities, including other banks. The digital settlement service, a tool for p2p transfers (transferring money from card to card) on the blockchain, became the prototype for the use of this technology at VTB. The bank notes, "The calculations do not involve the use of cryptocurrencies and are made in fiat currency - rubles."

Not only financial service institutions are looking to blockchain for operation efficiency and inter-organizational collaboration. Regulators are beginning to feel the advantages that blockchain technology offers. Regulatory bodies in Dubai, Singapore and India have given their seal of approval to blockchain and are providing support for either pilot projects or research studies with blockchain.

Being attractive to regulators due to increased transaction security and reduced risk of manipulation, this new technology creates complex legal and regulatory issues that states are trying to understand. Among US regulators, the US Securities and Exchange Commission (SEC) is actively exploring the possibility of blockchain for operations with financial services in the government securities market. In

November 2015, Kara Stein, the US SEC Commissioner, first talked about the potential of a blockchain to track systemic risk, for example, by monitoring re-use of collateral. Stein also warned that the market uses blockchain technology, "regulators must be able to manage, use their advantages and respond quickly to potential weaknesses." However, the use of the blockchain is still in its infancy, and many questions will need to be answered, including issues related to cybersecurity.

8 SOLUTIONS AND RECOMMENDATIONS

The chapter presents some intermediate results, including obtained earlier, namely:

1. Summarized the best practices of blockchain technology using in the financial markets.
2. Promising scenarios using blockchain technology for commercial banks were identified.
3. The experience of the regulatory sandboxes formation is evaluated. The sandboxes allow studying the use of the blockchain technology in financial markets in testing form or in the form of a limited regulatory tool.
4. Risk communities and groups of risks of parties most actively involved in the implementation or regulation of legal and illegal, regulated and unregulated use of the blockchain technology are identified.

9 FUTURE RESEARCH DIRECTIONS

In our opinion, the following areas of research will be relevant in the near future:

1. Strategic aspects of the blockchain technology application.
2. The optimal combination of centralized and decentralized approaches to legitimize the products of blockchain technology.
3. Diagnostics of efficiency and risk management of blockchain projects.
4. Search for optimal zones, forms, methods and limits of state regulation of blockchain technology application.

10 CONCLUSIONS

Legal risks, i.e. those causing a destabilization of legal regulation of the financial sphere do not only exist – they have manifested themselves already. They can be connected with an absence of regulation in some separate positions too, and with a non-optimum regulation or a total ban on the distribution and use of the blockchain technology, which is characterized as "retarded" or "non-overhelming" regulation. Financial authorities around the world study the realization possibilities of such legal risks; they monitor the behavior of innovators in the financial market and try to prevent big losses and points of a non-return to former, safe conditions.

We believe that the correct solution of the question of regulation of the blockchain technology implementation and use at the domestic financial markets is the important factor of competitiveness today. In this regard to increase competitiveness, from our point of view the following urgent measures are necessary:

1. The development of the block of "digital" standards of bank business and another block of "digital" standards for other participants of the financial market.

The development, where possible, of the standard "digital" contracts (contracts utilizing the distributed ledger technology, including the blockchain, basing, especially on the models with public and private chains of blocks) for the newly appearing products and services and/or the ways of their development, realization and rendering.

2. Studying the risk profile of business scenarios basing on the use of the blockchain technologies in the financial sphere.

Systematic comparative analysis of the risk-forming factors and the risks connected with non-regulated use of the blockchain technology in Russia and abroad.

Legal risk mapping in the context of business processes and products.

3. Development, adjustment and implementation of a legal risk-monitoring program in terms of its dependence on the use of blockchain technology.

Development of legal risk assessment methodology in the application of distributed registry technology.

Maintaining a register of losses from the implementation of legal risks, including those associated with the use of blockchain technology.

Examine the possible geography of the implementation of legal risk, especially in the presence of bank departments in other jurisdictions.

4. Preventively develop the procedure and content of the relevant changes in the constituent and internal documents in connection with possible and probable changes in legislation, describe the procedures for considering non-standard "digital" contracts (perhaps there will be a majority).

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KEY TERMS AND DEFINITIONS

Blockchain: Is a coherent ranking list, a continuous sequential chain of blocks containing certain information. The information is accessible to all members of a certain scenario and is stored on their various computers independently.

Risk Blockchain Communities in Financial Markets: Are groups of individuals exposed to the same risk associated with the use or regulation of blockchain technology; they need to manage this risk if it is manageable, and to adapt to it if it is not manageable.

Chapter 12
The Dynamics of the Global Value Chains and Disruptive Technologies:
Potential and Trends in Africa

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ABSTRACT

The advents of GVCs and disruptive technologies have provided alternative paths to industrialization and economic development for African countries, and with the transformation to digitalization now well under way, another conceptual shift is required to understand the evolving role of disruptive technologies in GVCs. It is evident that technological breakthroughs in the global markets have a spillover effect in the structural settings of African economies value chains, as lower tariffs and rapid technological changes have fragmented production across borders, but some African countries remain marginalized in GVCs. This study, therefore, attempts to preliminarily explain how African economies and markets capture value from disruptive technologies and create their competitive advantages within the global value chains context from the perspective of business-model innovation practices in African markets. Thus, developing African firms should not ignore those disruptive growth opportunities within the large population of mass customers and non-consumers in emerging economies.

INTRODUCTION

The digital economy and the new industrial revolution are fundamentally transforming the way firms operate internationally. In recent years, disruptive innovations and internationalization of firms from developing economies have attracted growing attentions in the area of innovation, new technologies, markets and management. Over the last few decades, emerging economies are prominently playing the role of being main driver for growth and market development to the world at large (Wright, Hoskisson and Peng, 2005; Hoskisson, Eden and Wright, 2002). However, in Africa, some firms have strategically

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adopted disruptive technologies from developed economies through business-model innovations and more so, the global value chains (GVCs).

Notably, the sudden occurrence of COVID-19 across the world has enlarged profound fault lines in the functioning of GVCs and uncovered the fragility of the model characterized by high interdependencies among leading firms and suppliers located across several regions. This further revealed all the insubstantiality to external shocks which led to parallel variability affecting production costs and make it difficult for businesses to recommence on a global scale, thereby leading many firms to reduce or stall their production activities. Intangible business operations such as research and development, design, marketing and branding, centered on unique resources and capabilities are largely still performed in headquarters, generating superior returns, often in the form of rents due to the pandemic.

Meanwhile, disintegration in production system of the GVC is driven by technological change, cost, resource availability, markets, pandemics and trade policy reforms, and determines the shape of African business economies. With the growth of GVCs and disruptive technologies, African economies and markets are becoming more interrelated and they are gradually focusing in different functions, activities and phases of value chains. In GVCs framework, innovations are typically described as economic advancement and enthusiasms of firms to improve the gain they generate and grab from the activities in GVCs (Gereffi, 1999). Firms with intensive technology often abandon innovations centered on disrupting technologies that produce novel products and offer potentials for competitive advantage (Kassicieh, Kirchhoff, Walsh and McWhorter, 2002).

However, the ability of the GVCs to create knowledge spill-overs and the role it plays in economic development cannot be over-emphasized. For instance, China has controversially deemed its economic success to be evidence of the advantage gained through collaboration with external firms within GVCs (Marisa, 2017). More so, the successful distribution of COVID-19 vaccines across many African countries is another notable evidence that China, United Kingdom, Russia, India and other developed countries have further gained advantage even in the face of the pandemic. The China's Sinopharm and Sinovac vaccines, UK's AstraZeneca, Russia's Sputnik and Covaxin from India are some of the vaccines recently been shipped into African economies to cushion the effects of COVID-19 pandemic.

In other hand, GVCs have been a vital feature of technologies for a few decades and have changed the way firms design, produce and distribute services. GVCs have also led to successful incorporation of disruptive technological developments which have undergone a dynamic process of globalization and have been crucial and continue to impact GVCs growth. In addition, GVCs are therefore populated by a constellation of experts and actors collectively responsible for bringing disruptive technological services to the African market and enable service providers.

Notably, cross-border market, trade, investment, technology and GVCs are seen as the engines of growth in a global economy (Jeffrey and Romero, 2018). This development has stimulated African businesses and Governments around the world to constantly extend their networks through free trade agreements and have direct access to markets across international borders. GVC is thereby seen as an array of processes or activities undertaken to show that a particular kind of product or a particular kind of service gradually through the conception to final stage, and consequently distributed across international boundaries (Sean and Aditi, 2018). More so, GVC focuses on the full range of activities from the conception, through the phases of production to its end use and beyond of a product or service.

Nevertheless, dwindling costs of services, technologies advancement and relatively easy transferability of inputs and components across countries have made it easier for proper coordination of production processes. More so, the possibility of companies to monitor their various stages of production process

across different nations of the world and reduction in barriers to the movement of services and investment through free trade agreements had been crucial to development of African markets.

Multinational enterprises (MNEs) which operate as lead firms are key players in GVCs across border through independent suppliers, strategic partners and foreign subsidiaries (Sean and Aditi, 2018). These lead firms set standards that need to be fulfilled by the suppliers of services throughout the value chain. This subsequently governs economic considerations such as timing, quality, performance and cost of inputs. The contributions of small and medium-sized firms are also important in GVCs, which have been proven to be one of the unusual ways countries could attain economic development, especially in the developing countries, as they made up of the majority of firms and provide job, generate growth and help tackle poverty menace.

However, disruptive technologies such as drone technology, 3D printing, virtual and augmented reality, the Internet of Things (IoT), artificial intelligence (AI), cloud computing, Big Data, wearables and advanced robotics have modified business cycles and re-allocated the activities and functions of firms enabled in the global value chains (Marisa, 2017). Disruptive technologies have forced scientific and policy perspective on global value chains with which many chain leader firms from Germany, USA, Japan and South Korea are gambling on new order of business environment and business models at a global level, and they are not only backed by the need of firms to leverage new frontiers of competitiveness, but also by political claims. Also, the recent relocation of some production processes to the developing nations is typical example of a new order of business environment.

Initially, disruptive technologies costs more and most times does more than the existing technologies which makes it often actively regards as a threat by rivals, but now it evolves into a high quality performance and somewhat low-cost offerings that pushes out traditional technology. Today, data-driven technologies are evolving as a game-changing disruption that is already transforming and will continue to transform business model and global value chains.

Emerging economies are considered as perfect and enviable markets for disruptive technologies (Hart and Christensen, 2002; Hang and Chen, 2008). African economies are fast rising adopters of disruptive technologies which somewhat threaten global value chains. The emergence of social media, 5G, Uber, Bolt (Taxify) and LTE (Long-Term Evolution) technologies are some of the prominent disruptive technologies which have impacted business models in Africa. More so, the modern management systems in some sectors of the economy in Africa such as financial, manufacturing, agricultural, ICT sector and others have been radically transformed. This also has strong bearing on the prevailing industrial processes and frameworks that drive export markets through linkages to the global value chains.

Therefore, it is evident that technological innovations in the global markets have spill-over effects in the structural settings of African economies value chains. For instance, the much known Uber transportation firm whose mobile software automatically link up customers who need rides with drivers who are readily available to render the service. Uber has enjoyed dramatic growth since its inception in 2009 and has reportedly thrived in over 60 countries (including Africa countries such as Nigeria) with estimated enterprise value around $50 billion (Clayton, Michael and Rory, 2015). Uber has clearly transformed taxi business in the United States, while also expanding in other countries.

GVCs and disruptive technologies have stimulated growth in many developing economies in the last two decades, and income realized from their trade flows was found to have doubled between 1995 and 2009 and improved six-components for China, five-components for India and three-components for Brazil. Although, participation in GVCs demands openness and integrated trade in goods, services and new technologies and these remain uneven across countries of the world (Jeffrey and Romero, 2018).

More so, trends in technology, globalization and the regulatory framework have fostered massive offshoring of low-value-adding and wage-sensitive activities at the bottom of value chains to African economies with limited productive capacities. This study therefore used business-model innovation practices' perspective to explain how emerging African economies and markets benefit from disruptive technologies by gaining competitive influences in the global value chains setting in African markets even in the face of COVID-19 pandemic. This study also raises policy concern and the will to reshape policy thinking of African economies towards GVCs and disruptive technologies.

BACKGROUND

Global Value Chains

Value chain focuses on the activities of a firm and the strategic role of the relationships with other firms and actors (Xiaobo, Rufei and Yongjiang, 2010). However, the term "Global Value Chain" reflects a comprehensive drive towards the dispersal of value chain activities across countries around the globe. GVCs processes varied across industries, firms, products and services, which make many firms, disintegrate their value chains and distribute production activities across many nations, and simultaneously outsourced components of their value chains to external partners. Nevertheless, some of the constituents of the chain embrace the standard assembly-line arrangement, where products or services undergo sequential processing, while other activities involve the assembly of several intermediaries into products or services (Baldwin and Venables, 2010).

The dynamic nature of GVCs will continually develop as firms' expenditures rise and technological operations continue to evolve. Figure 1 below depicts a typical global value chain, where the value chains stages are implemented in the locations best recognized in the activity. Activities such as the manufacture of parts, final assembly and selling of the final goods engage a number of countries. The method of trade typically indicates that goods manufactured in a particular country are exported or moved to its market for final usage, while inputs are delivered by producers in another countries (known as first-tier suppliers) who themselves sourced their inputs from developing countries (known as second-tier suppliers).

The recent increase in economic integration at international level is keenly connected to GVCs growth. Countries like China, Brazil and India have become main actors in the global economy, in part because of their growing and active involvement in GVCs (Organisation for Economic Cooperation and Development (OECD), 2013). Similarly, due to extensive policy reforms coupled with technological change, African economies have amassed wide-ranging activity in services and manufacturing industries. For instance, services such as Information and Communications Technologies (ICTs) which are directly connected to GVCs have simplified sourcing of such service activities from foreign countries. The advancement and adoption of new technologies in Africa has improved the rapid exchange of service activities and generated new kinds of services, thereby meaningfully transforming the nature, shape and interconnectedness of the global economy. Thus, the ICT revolution and advancement such in the technological breakthrough backed the growth of GVCs (Baldwin, 2009)

GVCs are evident in emerging countries due to radical development and changes in domestic and global regulatory frameworks and consequential technological and management practices (Pietrobelli, 2008). GVCs often serve as one of the rare alternatives for suppliers and firms in African economies by gaining access to bigger markets and disruptive technologies. More so, many African firms have

seen participations in global value chain as an important avenue for reliable information needed and the requirements to gain full access to global markets.

Figure 1. Schematic representation of a Global Value Chain
Note that point 2, 3 and 4 represent intermediate products which are combined into 1 (final product), while 4 as an intermediate product itself is composed of inputs 5, 6 and 7.
Source: (Adapted from OECD, 2012)

A. The Drivers and Main Actors in the Global Value Chains

The advent of GVCs and the global disintegration of production cycle and system are continually driven by transformations in the business and regulatory environments in conjunction with the shifts in corporate think-tank in addition to business organization (OECD, 2013). In Africa, outsourcing and offshoring in global business strategies have been subsequently considered by firms due to decreasing costs of trade and the sinking costs of communication have allowed the transnational sourcing of intermediates easier and much cheaper. Costs of trade are more likely to play crucial role in GVCs as costs have significantly lessened over the years, and even though intermediaries often cross borders many times in GVCs (Ma and Van Assche, 2010).

For instance, long before COVID-19 in Africa, disruptive technologies were known for promoting a rearrangement of GVCs relating to significant relocation (and reshoring) of productive activities, unlocks new labour-saving technologies, which could potentially reduce reliance on low-skill labour in manufacturing and therefore reduce the benefits of offshoring. However, disruptive technologies have significant effects on the global geography of production, as value chains will become more regional in nature, moving closer to consumer markets where ecosystems are more supportive to business, especially in African markets.

The rising investment autonomy through bilateral and multilateral agreements have permitted firms across the African continent to use foreign direct investments to extend their production cycles, and investment strategies, thereby integrating them in GVCs. For instance, the Information Technology

Agreement has removed tariffs on information technology services/products and has stimulated GVCs in the ICT industry in Africa. More importantly, powerful, cheaper and more reliable new and disruptive technologies have considerably eradicated the high cost of conducting and coordinating complex business activities across borders, both within and between firms around the world (OECD, 2013).

The globalization of value chains has been driven by unrestricted access to international markets by African firms, as it gives them better understanding on how to gain full access to markets abroad. Also, demographic changes, rapid growth and increasing share of African countries in the global economy activities have triggered participation in GVCs. OECD (2011) put forward that firms' presence, market extent and expansion are considerably some of the significant goals for locating distribution, sales and production activities of a firm in any economy. More so, the presence of partners in international markets guarantee protection for African firm's proprietary knowledge, as they would gain access thereby leveraging on more readily opportunities on its intellectual property (OECD, 2013).

Exploiting and gaining from foreign knowledge has become a crucial driver of internalization of R&D and innovation activities in Africa as firms could move some crucial activities in the GVCs to gain access to skilled workers, technological expertise, competitors, suppliers (strategic assets) and learn from their experience in the process. The presence of the so-called "strategic assets" and rising competitiveness in African and global markets are pertinent to productions and distributions in the offshore with more effectiveness and reduced costs.

According to Gereffi, Humphrey and Sturgeon (2005), the main actors in GVCs are MNEs, their partners/ conglomerates overseas and the autonomous producers in both local and international marketplaces, while the business dealings within the GVCs involve intra-firm dealings among the headquarters and partners, also among firms and autonomous dealers. Also, the nature of the dealings, the ability to organize dealings and the competencies would determine the shape and the density and spread of the profits and risks (Gereffi and Lee, 2012).

Thus, the various roles of MNEs and autonomous suppliers in the GVCs can easily be reflected by establishing the divergent among "producer-driven" and "buyer driven" value chains (OECD, 2013). The GVCs that are producer-driven are notably seen in high-technology sectors which include the automotive, electronics, pharmaceutical and the semiconductor industries, as they relied on R&D and huge technology. Distinctive examples are Sony, Toyota and Apple which control the products design and the larger parts of the assembly which could happen in several countries. Technological design and production experts are principal capabilities mostly developed by the lead firms, while the roles of firms in the networks are shown in their strong linkages with partners in other countries.

However, buyer-driven GVCs are mostly known for their developed large retailers and highly successful brands. The major roles of the lead firms in the GVCs are absolutely on promotion and sales, as their products are often moderately simple which seemingly requires little capital and relatively few skilled workforces. They characteristically owned few factories/ plants, but derive products from a huge network distribution of autonomous suppliers. Therefore, as a result of their involvement in international trade, market and venture, MNEs are major players in GVCs (OECD, 2013).

More importantly, players and linkages in GVCs could develop from small firms by upgrading their production systems and reinforcing their strategic business positions. SMEs in Africa mostly find it difficult to reach and break into the international markets, even with new opportunities to enlarge their business horizon overseas. The disintegration of production processes with advances in new and disruptive technologies is building innovative entrepreneurial opportunities for SMEs in Africa to gain access

to markets abroad, leading to other business classification known as "micro-multinationals" (these are known as smaller firms that promote and support global activities from onset).

The emergence of disruptive technologies and new business models in Africa ensures that these smaller firms (mostly service-driven) reach and enter international market at minimal costs. Hence, SMEs in Africa are confronted with difficulties in areas of managerial, finances and their ineptitude to easily upgrade/ innovate, protect and modify adopted technologies. Some other obstacles to successful integration of GVCs in Africa are inadequate resources to maintain the costs of R&D, competent personnel and the inability to fulfill the stringent requirements in product quality and standards.

DISRUPTIVE TECHNOLOGIES

The word "disruptive technology" was originally used by Christensen in 1997 in his work. However, scholars such as Hang, Yu, and Chai (2007), Utterback and Acee (2005) and Danneels (2004) posited that Christensen did not consistently and precisely define the term. Utterback and Acee (2005) defined disruptive technology as a novel or innovative technology characterized by lesser cost and measured by traditional performance and criteria, but has greater auxiliary performance. However, disruptive technology refers to as a special kind of technological advancement that functions through a specific pattern and has specific outcomes, which can be constructive or destructive, depending on the nature of business model in operations.

The Disruptive Technologies Model

For economies and firms who aimed to exploit and gain added advantage from disruptive technologies, commercial or business models captured in markets low-end must be gainfully used more extensively than the commercial or business models in high-end markets. Therefore, disruptive technologies originate from new-market or low-end footholds (Clayton *et al*., 2015).

Low-end markets or footholds exist as incumbents firms which characteristically provide the most profitable, trustworthy and demand-driven customers with ever increasing services/products and pay less attention to lesser demand-driven customers in the market model, while new-market model exist as disrupters which create a market where none exist, that firms find ways to turn non-consumers to consumers. The Figure 2 below typically explains the disruptive technologies model indicating how services/products improve over time (product performance trajectories) as well as customers' willingness to pay for performance.

Also, the introduction of higher quality services/products by firms to gratify the high end of the market overshoots the necessities of low-end customers and many conventional customers. This eventually creates opening for new entrants to discover footholds in the less-profitable sections that incumbents are ignoring.

Figure 2. Schematic representation of Disruptive Technologies Model
Source: (Adapted from Clayton et al, 2015)

To match the imbalance, radical innovation centered on loftier technologies often has higher failure rate and demands considerable investment in funding, time, dedicated management supports and experts (Hang and Chen, 2008). Therefore, this explains that disruptive innovation is an effective approach and source of manufacturing more inexpensive products for the developing marketplace and present higher success prospect especially for evolving local enterprises (Xiaobo *et al*., 2010).

CONNECTING DISRUPTIVE TECHNOLOGIES AND GLOBAL VALUE CHAINS IN AFRICAN ECONOMIES

The phenomena of technological paradigm shifts open windows of opportunity for emerging economies firms' to realise technological leapfrogging by importing disruptive technologies to lessen business risks and R&D investments from developed nations (OECD, 2013). Leveraging on the critical roles played by MNCs in attracting investment is crucial to developing countries participation in GVCs and it offers the foundation to diversifying exports.

Before the advent of GVCs and disruptive technologies, developing economies were majorly demoted to producing primary goods, while moving up the scale of the value chain to create and export manufactured goods was problematic. The emergence of GVCs and disruptive technologies have been advantageous to developing economies as they can now export manufactured products rather than only primary products, with the full range of supporting institutions, infrastructure and human resources (Wang and David, 2018).

However, Africa is focusing more on industrializing its economies. The evolving fourth industrial revolution is becoming more evident in African continent as data exchange and automation in manufactur-

ing and service technologies such as the cyber-physical systems, the Internet of Things, cloud computing, and cognitive computing are on the rise. This new digital industrial technology allows faster collection and analysis of data across machines, leading to more efficient and flexible processes for higher quantity and quality production at minimal costs.

In the dawn of globalization and disruptive technologies, domestic value chains in Africa are gradually subjected to shorter life cycles, leading to emergence of new sets, while resulting into changes in existing market structures and industries, consequently affecting business models (Mandizvida, 2016). Disruptive technologies tend to exert great pressure on existing value chains in Africa, sometimes resulting into total disappearance of existing value chains along with the firms or markets that drive them, but such markets could eventually lead to modified value chains emerging from new market dynamics.

These modifications could have been enabled by amalgamation of market liberalization models and economic rearrangement in African countries, especially from foreign trade, financial deregulation, investment liberalization, global integration of capital markets, technological advancements and improved contract enforcement and protection of intellectual property rights.

However, the Global Value Chain Report published in 2017 by the World Bank and the WTO discussed the recent trends around GVCs and their effects on international trade and development. The report put forward that African economies lag behind other continents of the world in participating and integrating into GVCs, particularly showed little intra-regional integration (Figure 3).

Notably, the measure of integration in GVCs are diverse as several low-income economies, especially in Sub-Saharan Africa where integration are mostly done at primary segment of the chain, coupled with the upgrading to higher value-added initiatives or diminutive expansion, compare to other regions in Europe, Southeast Asia and North America (World Bank, 2017). Furthermore, where integration and participation does occur in Africa, they are very much at the lower value end of GVCs, where exports mainly come from natural resources and imports of intermediate products generally satisfying domestic demand.

Figure 3. Extraregional and intraregional trade in intermediates (2014)
Source: (Adapted from World Bank, 2017)

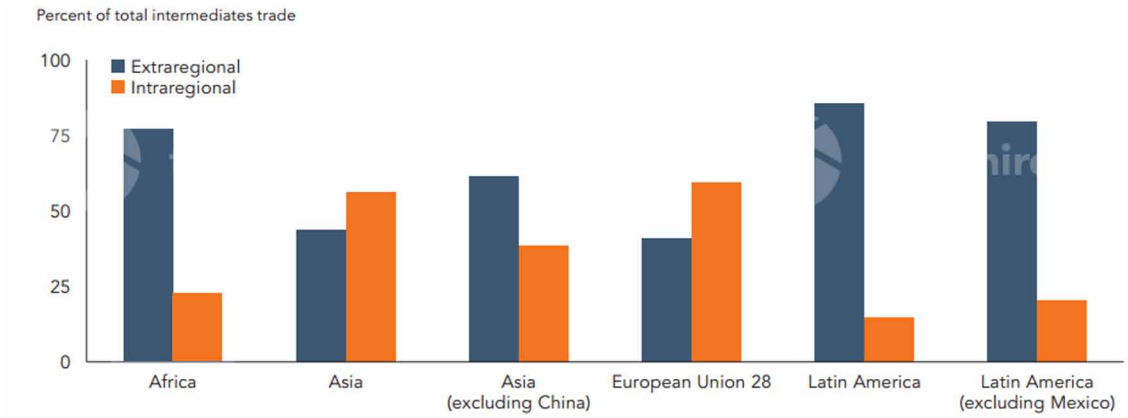
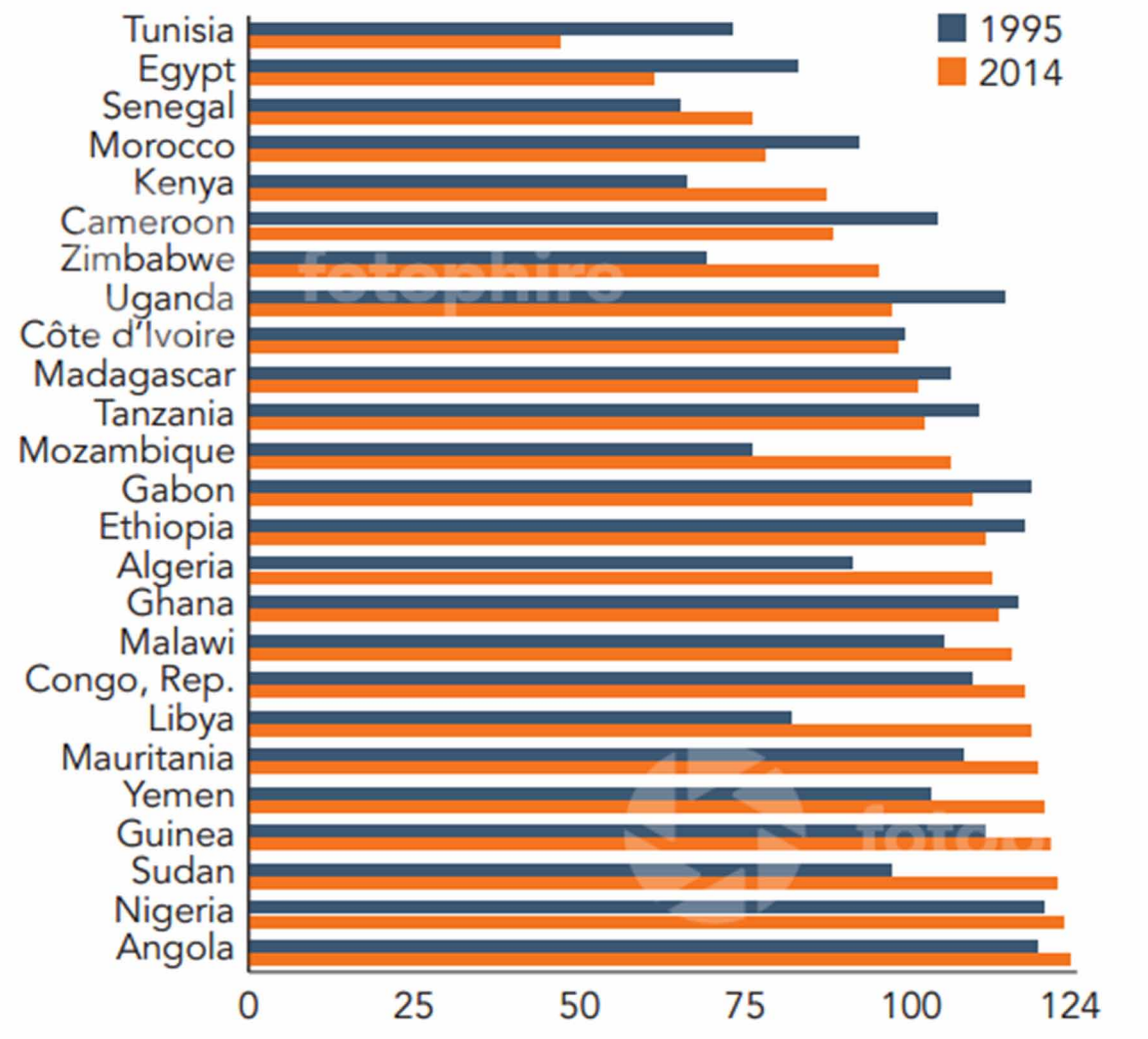


Figure 4. Economic Complexity Rankings in Africa for 1995 and 2014
Source: (Adapted from Hausmann, Hidalgo, Bustos, Coscia, Chung, Kimenez, Simoes and Yildirum, 2011)
Note: Rankings are among 124 economies, with a ranking of 1 reflecting the highest complexity and 124 the lowest.

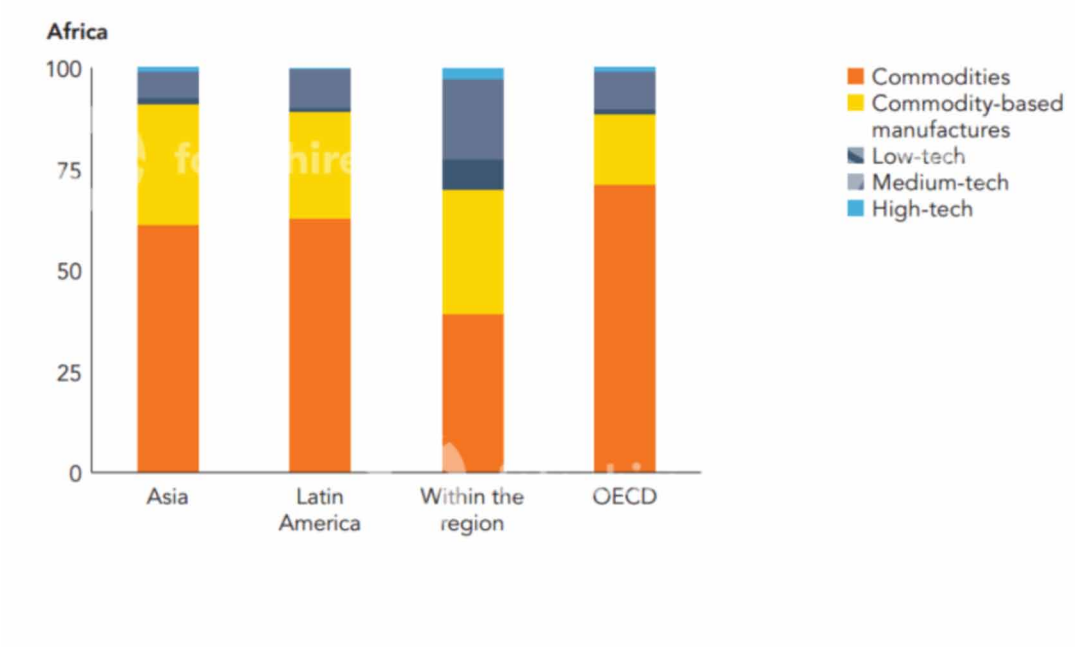


However, many African countries have integrated and participated in GVCs and have seen themselves as "captive participants" as they experience challenges in scaling up and are being locked into low-value functions of the value chain. Apparently, these countries have limited capability to expand or upgrade, as they are often weakened to price war that lowers their income per capita. These African countries, for instance have seen only about 0–2% rise in GDP per capita in the last few decades and occasionally even more, as in the case of Angola (Figure 4). Furthermore, over the last two decades, most African economies showed little improvement in ranking, but more exceptionally were the Northern African countries given to their nearness to European value chains and markets.

From technological context and exports, the technological level and structure of exports in Africa and Latin America are largely low, compare to other regions of the world. This largely explains the poor performance of African countries when it comes to areas of technological capabilities and economic

complexity (Figure 5). African firms are mainly confronted with formidable challenges in adoption of disruptive and new technologies. Although, intraregional integration in disruptive and new technologies is characteristically in higher value where it does occur, and Africa countries could learn and explore.

Figure 5. Regional exports by share of technological intensity (2014)
Source: United Nations Comtrade database (2015)



EMERGING AND FUTURE TRENDS FOR GVCS AND DISRUPTIVE TECHNOLOGIES IN AFRICA

Global Value Chains are increasingly transforming and evolving given to the pressure of new and disruptive technologies. The 3D printing, virtual and augmented reality, artificial intelligence, Big Data, the Internet of Things (IoT), cloud computing, wearables and advanced robotics, and the rise of innovative firms are changing the sources of value added in the entire sectors and industries. Though digital and new technologies offer productivity enhancing instruments, but many may also be disruptive in nature and poses challenges for international cooperation.

In African, many practices that used to be labour intensive in nature are gradually shifting to computer-aided technology, while larger share of low wage African countries exports is being rapidly automated by their trade partners. However, this technological transformation has evoked uncertainties that industrialization led by labour intensive exports may no longer be tenable for African countries leaping for growth and scaling up the value chain in the nearest future.

Therefore, African countries pursuing to gain from GVCs and disruptive technologies must be ready to steer policy in new directions for both national and global growth (World Bank, 2019). More importantly, they must have sound and operational logistics and effective business environment to enjoy

the developmental gains of trade and investment. More so, at a time when timely production of critical products is more important than ever, amid of COVID-19 pandemic that has locked down vast parts of the world and limited economic activities in an unprecedented way, the current pandemic will reinforce relocation and reshoring trends. With most economies under full or partial lockdown and with trade and investment contracting, the future of offshoring is more uncertain than pre-COVID-19.

However, it is imperative to emphasize the primary forces behind the current wave of disruptive technologies and global chain values which are globalization and demographic changes. Thus, understanding the interaction between these forces would shape the future of African markets into large and transformative patterns that explain the present and future by their impacts and potentials on economies, markets, businesses, industries, societies and individuals. Disruptions in GVCs might extremely affect economies and markets, but governments could gain from achievements and more systematic insights on the position and presence in GVCs.

CONCLUSION

This study attempts to preliminary explain the impact of disruptive technologies on global value chains and how it affects African markets. Also, the study provides the essential in understanding how global value chains operate, impact economic performance and ways policy could assist African markets benefit in their participation and integration in the global value chains in the face of emerging disruptive technologies.

However, the roles that nation's most innovative enterprises can contribute within global value chains are crucial to industrial revolution and market development of Africa. The sudden and successful evolvement of many start-ups in 3D printing, IoT, cloud computing and robotics, and robust support by Government establishments equally explains the sudden and successful change in the role of national industry at the global level. African markets must therefore endeavor to move up the ladders of GVCs, by creating niches in international markets.

GVCs are evolving and will continually do so due to regular increase in costs, change in technologies as well as firms continue repositioning of their operational business models. More importantly, value chains are evolving and strengthening business structures in Africa, but sometimes warranted limited production functions for firms from developed nations. This may provide new opportunities for African economies that have thus far not participated and integrated in GVCs.

Furthermore, entrance to global markets, networking, information, investment and technology gains through integration and participation in a GVC can trigger economic development. African markets can embrace and enter the GVCs by opening up their economies to international trade and foreign direct investment (FDI) by supporting local capabilities through proper engagement in foreign trade. In accomplishing this, African countries and firms must strengthen their business environment, stimulate investment in design and R&D, and promote the growth of economic competence such as management and skills.

In African markets, COVID-19 could accelerate and allow for more flexible adjustment to changing demand, mitigating firms' risks in the event of a pandemic or other external shocks. Furthermore, supply chain and production disruptions caused by COVID-19 might undermine economic integration and encourage self-sufficient economic systems in some strategic sectors or the production of inputs for

assembling sophisticated technologies. This tendency is reflected in the growing number of temporary export bans and restrictions on critical goods enacted by numerous countries after the outbreak.

However, for African economies to reap development benefits and distribute gains more equitably from GVCs and disruptive technologies, pure trade policies and instruments are inadequate, but proper incorporating of economic policies and strategies that would help build local ecosystems, networks and institutions are crucial. Therefore, successful and outperforming African countries and firms need to depend on numerous features of the disruptive technologies by leveraging on knowledge dynamisms and flows outside and within the GVCs to develop and build competitive and horizontally capacities into new GVCs. Meanwhile, those seeking to climb up the value chains need to open service sectors to import competition and FDI by improving access to finance, communications, transports and other major services.

In addition, reinforcing regional value chains should be a priority for African countries to diversify risk, reduce vulnerability, increase resilience and foster industrial development. Identifying and maintaining horizontal and vertical linkages can ensure that African SMEs cooperate to reduce transaction costs and benefit from economies of scale. This can also help favour connectivity among different specialized firms whose inputs are directly integrated in the global supply chain.

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Chapter 13
Towards a Sharing Economy:
Factors, Trends, Risks, and Prospects

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ABSTRACT

The purpose of the research is to explore factors, trends, and prospects of the sharing economy in economic systems of various types. To achieve this goal, the authors established a typology of countries according to their sharing economy development. Based on the structural and rank analysis, the authors investigated and compared national economic systems according to the level of the sharing economy development. The authors also employed the expert survey method to identify factors and risks affecting the sharing economy at the national level. The following factors have been identified: digital economy development, the openness of citizens and businesses to innovations, consumer mentality affecting behavior patterns, regulatory at the national and local levels, availability of the services, simplicity and quality of the infrastructure, trust, political situation in the country, and digital literacy of the users.

INTRODUCTION

The global environmental crisis requires a new paradigm of a sustainable economy and necessitates the development of technologies which allow to stimulate increases in living standards on the one hand and

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to preserve human habitats as well as the integrity of the environmental system on the other hand at the same time at the national and international levels.

The digital economy as a trend of the 21st century carries with it serious implications for solving economic and ecological problems:

- expansion of services received via the internet (including mobile internet), ensuring accessibility and breadth of service coverage;
- growth in the service sector and in employment leads to the development of new forms of business typical for the digital economy; both governments and businesses have an interest in the creation of new employment opportunities, a solution to the issue of self-employment, boosting the competitiveness of national economy at the world market of services;
- a shift in consumer psychology, a transition from the mass consumer mentality to sustainable consumption of goods and services can be a serious challenge and a powerful brake on the sharing economy because management of consumer behavior can become a competitive tool for national and transnational companies which threatens the national security;
- development of digital technologies is an underlying condition for the growth of the sharing economy, since the mobile internet creates the environment where supply and demand interact without intermediary which carries with it a serious challenge for government: if the sharing practices are not commercial, how can the problems of risk insurance, protection from fraud, taxation be solved.

  Thus, several studies consider the advantages and concerns posed by the sharing economy, some factors, and risks influencing the sharing economy are overlooked. This inhibits to understand commonalities and differences in the sharing practices of different countries. Comparative research of the sharing economy implementation in various economic systems is lacking in the scholarship. This study seeks to close this gap.

The purpose of our research is to explore factors, trends, and prospects of the sharing economy in economic systems of various types.

To achieve this goal, the authors intend to consider the following research questions.

1. What factors play a crucial role for the sharing economy practices?
2. What challenges and concerns has the sharing economy brought to the country?
3. What kind of measures and policies would facilitate the sharing economy practices?

The study is structured as follows: Section 2 reviews the sharing economy related literature, Section 3 presents the methodology, Section 4 analyses the empirical results obtained, and Section 5 presents the conclusion.

SHARING ECONOMY BACKGROUND

Although the concept of the sharing economy is simple and not new, there is no the only one commonly agreed definition (Görög, 2018). This is due to a number of reasons. One the one hand, the sharing economy is considered to be a complex and multifaceted phenomenon that leads to its ambiguity and

produces a lot of related terms (Leung, Xue, Wen, 2019). Dredge and Gyimóthy (2015) identified 17 concepts associated with the notion of the sharing economy. Görög (2018) reveals 26 terms used interchangeably. She identified 15 most popular notions and investigates the difference between them. Among the most common parallel terms scholars call "collaborative economy", "gig economy", "mesh economy", "on-demand economy", "platform economy", "peer economy", "collaborative consumption" etc. (Mulcahy, 2016; Parker, Van Alstyne, Choudary, 2016; Ganapati, Reddick, 2018; Ma, Lan, Thornton, Mangalagiu, Zhu, 2018).

Other reasons for the lack of a shared definition are rapid development in this area (Hawlitschek, Teubner, Adam, Borchers, Möhlmann, Weinhardt, 2016) and the complexity of the phenomenon including various products, services, and industries (Leung, Xue, Wen, 2019). For that reason, the sharing economy has been a research subject of many academics with different disciplinary backgrounds including geographers, management scholars, sociologists, environmental scientists (Boons, Bocken, 2018).

Several scholars consider the sharing economy as an umbrella construct for a variety of for-profit and non-profit, business-to-consumer and peer-to-peer setups that enable the compartmentalization of ownership and the usership of goods, skills, and services (Acquier, Daudigeos, Pinkse, 2017; Netter, Pedersen, Lüdeke-Freund, 2019). There are also narrower terms such as developed by Finck & Ranchordás (2016) who defined the sharing economy as any technology based collaborative peer-to-peer practice that involves either temporary access to an asset or the provision of services.

While the sharing economy has a significant impact on the economy and society, it is still filled with paradoxes and regarded as an ambiguous phenomenon. Schwartz & Einarson (2018) summarize the ideas and views on the sharing economy into two categories: optimistic view regarding it as a cooperative vision of personal exchanges, emphasizing collaboration and openness, and critical view that focuses on its exploitive force. Some scholars point to the negative sides of the sharing economy and contemplate whether its potential advantages can overweigh negative consequences. Leung, Xue, & Wen (2019) conclude that the sharing economy is not in healthy shape yet and needs some more regulation.

We have summarized the views of contemporary scholars on the positive and negative sides of the sharing economy and present them in Table 1.

Although the concept of the sharing economy is explored from all points of view, an extensive review of the literature reveals the lack of studies investigating the evolution of the sharing economy sectors and the specific of this evolution in different countries. Therefore, new methods which can be used to investigate and compare the national economies evolution will contribute to the sharing economy research.

Research Methodology

In this paper, the research is based on structural and rank analysis. This method allows the scholars to estimate the structure and dynamics of the sharing economy and to compare its development in different countries in view of their division into developing and developed economies.

During the investigation, we systemized factors influencing and shaping their behavior patterns on the market for goods and services.

In order to investigate the evolution of the sharing economy sectors and evaluate risks of the sharing economy, the authors employed quantitative (factor analysis, regression analysis, cost recovery method, sensitivity analysis) assessment methods. Besides, the authors applied the qualitative method (expert analysis) to obtain additional information concerning factors, risks, and prospects of the sharing economy.

Table 1. Advantages and drawbacks of the sharing economy

Advantages of the sharing economy	Source
Environmental effects	Görög (2018); Boons & Bocken (2018); Ma, Lan, Thornton, Mangalagiu & Zhu (2018); Ganapati & Reddick (2018); Leung, Xue, & Wen (2019)
Social effect	McLaren & Agyeman (2015); Görög (2018); Leung, Xue, & Wen (2019); Migai, de Jong & Owens (2018)
Economic benefits	Görög (2018); Leung, Xue, & Wen (2019); Thomas (2017); Migai, de Jong & Owens (2018); Leung, Xue, & Wen (2019)
Mobility	Ganapati& Reddick (2018); Ma, Lan, Thornton, Mangalagiu & Zhu (2018)
Enhancing the attractiveness of the city for residents, visitors and commuters	Finck (2016)
Promoting the development of poor neighborhood	Finck (2016); McLaren & Agyeman (2015).
Development of infrastructure	Thomas (2017); Mariotti, Pacchi & Di Vita (2017)
Drawbacks of the sharing economy	**Source**
Lack of legal regulation	Leung, Xue, & Wen (2019); Finck (2016); Ganapati & Reddick (2018); Domenech-Pascual (2016); Hou (2018); Migai, de Jong & Owens (2018)
Working conditions, employees protection	Gibbins (2018); Ganapati& Reddick (2018);
Unfair competition between traditional businesses and sharing economy companies	Leung, Xue, & Wen (2019)
Potential monopolization of the sharing economy companies	Srnicek (2017); Ma, Lan, Thornton, Mangalagiu & Zhu (2018); Leung, Xue, & Wen (2019)
Risk of ownership to clients	Bellin (2017); Leung, Xue, & Wen (2019)
Trust	Cheng, Fu, Sun, Bilgihan, & Okumus (2019); Hawlitschek, Teubner, Adam, Borchers, Möhlmann, Weinhardt (2016); Hou (2018)
Security	Teubner & Flath (2019)
Data protection	Teubner & Flath (2019)
Tax evasion	Thomas (2017); Migai, de Jong & Owens (2018)

They conducted a descriptive evaluation of the sharing economy factors, risks, and prospects by means of structured interviews.

The qualitative phase of the study involved experts participating in the sharing economy businesses (start-up leaders, platform developers, sharing economy project leaders) and government officials responsible for digital economy implementation in the cities of Russia. Face-to-face semi-structured interviews were chosen as a survey method to ensure completeness of study. Brenner (2006) argues that "a semi-structured protocol has the advantage of asking all informants the same core questions with the freedom to ask follow-up questions that build on the responses received". A semi-structured interview guide was developed on the basis of the current literature. A total of 32 professionals agreed to participate in the survey. The study ran for three months: from February to April 2019. All interviews were audio recorded. Then they were transcribed to prepare them for qualitative analysis.

Most respondents were male (21). All the experts had higher education. Ages ranged from 26 to 48 years. 18 government officials and 14 sharing economy users were interviewed. The socio-demographic characteristics of the respondents can be seen in Table 2.

Table 2. The socio-demographic characteristics of the respondents

Nº	Age	Gender	Occupation (Government/Business)
P1	28	Male	Business
P2	26	Male	Government
P3	44	Female	Business
P4	34	Male	Business
P5	47	Female	Government
P6	29	Female	Government
P7	41	Male	Business
P8	42	Male	Business
P9	29	Male	Government
P10	48	Female	Government
P11	26	Male	Business
P12	38	Female	Government
P13	31	Male	Business
P14	39	Male	Government
P15	27	Male	Government
P16	45	Female	Government
P17	26	Male	Business
P18	27	Male	Business
P19	38	Female	Business
P20	44	Male	Business
P21	27	Female	Government
P22	31	Female	Business
P23	32	Male	Government
P24	28	Male	Business
P25	43	Female	Business
P26	45	Male	Government
P27	47	Male	Business
P28	28	Male	Business
P29	28	Female	Government
P30	31	Male	Business
P31	32	Male	Government
P32	42	Male	Government

SOLUTIONS AND RECOMMENDATIONS

Justification of the Connection Between Digital Economy, Sustainable Economy and Sharing Economy

The modern period of the digital economy is considered to be a part of the fourth industrial revolution (also called "Industry 4.0"). Therefore, it is worth comparing its effects with the impact of the previous stages of scientific and technological progress on the state, economy, and society. The results of this comparison are presented in Table 3.

Table 3. Evolution of scientific and technological progress

Implementation areas	**The first industrial revolution**	**Automatization (the second industrial revolution)**	**Informatization (the third industrial revolution)**	**Digitalization (the fourth industrial revolution)**
	Industry 1.0	*Industry 2.0*	*Industry 3.0*	*Industry 4.0*
Economy	Emergence of the industrial sector, shift from manual labor to machine- related jobs	Conveyor production. Growth of large-sized machine production	Adoption of software in automated and manual processes	Digital technology development and implementation to increase diversity and efficiency of business processes
Government services	Sophistication of the quality and range of services	The problems of unemployment and of increasing mass-production sale	Adoption of information technologies by governments. Implementation of results-based management to increase cost-effectiveness	Adoption of artificial intelligence and other digital tools by governments (e.g., European Charter on the use of artificial intelligence in the judicial system)
Domestic sphere	Rapid growth of labor productivity; the high rates of urbanization	The rise in living standards; changes in the level of labor skills	Distribution of information technology in everyday communication and consumption areas	Expansion of digital literacy and promotion of correct behavior in the context of digitalization
Changes in the structure of the gross value added	Industrial sector is engaged in competition with agrarian sector	Industrial sector displaces agrarian sector	Service sector starts to prevail over the industrial sector	The volume of the digital economy grows in the intangible assets sector

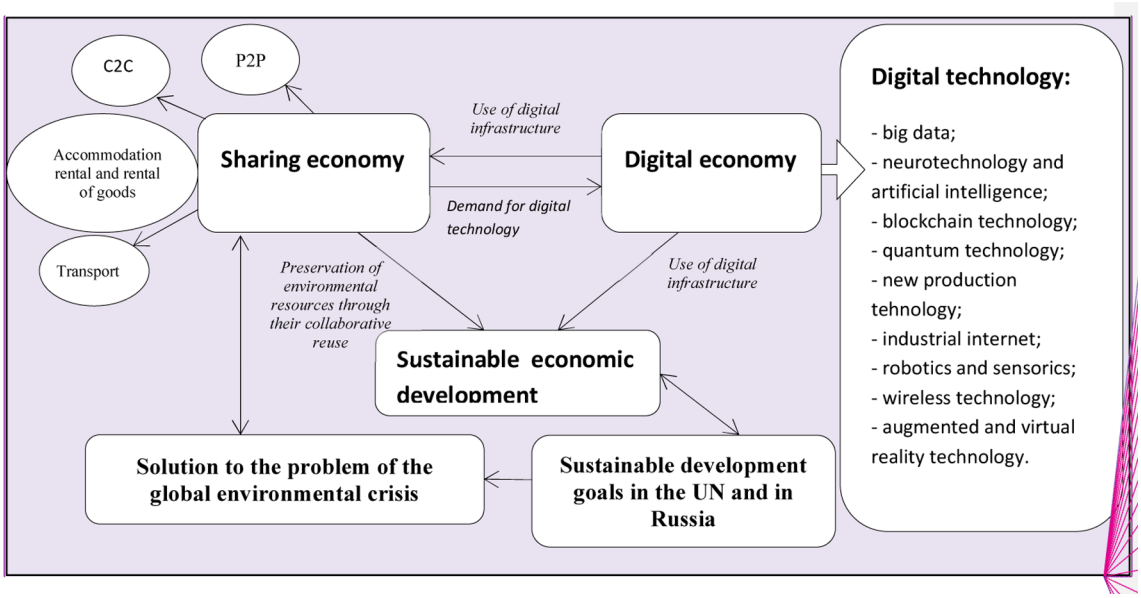
A number of scholars argue that digital technology adoption allows solving a lot of economic and ecological problems of modern state and society (Kagermann, 2015; Randall, Berlina, Teräs, Rinne, 2018; Stock, Obenaus, Kunz, Kohl, 2018). Two main advantages of employing digital technology in the sphere of economics have been identified. First of all, human factor problems are recognized to be the most important. However, there are some economic activities where artificial intelligence adoption could make it possible to minimize the loss caused by economic mismanagement and errors in doing operations.

Industrial impact on the environment by mining and mineral processing is considered to be a crucial problem. Digital tools allow improving the quality of pollution monitoring; treatment facilities become effective and environmentally friendly.

Meanwhile, the sharing economy facilitates in greater extend development of the sustainable economy through the digitalization of economic activities and accessibility of a great number of goods. This correlation can be seen in Figure 1.

The sharing economy can include car sharing and carpooling as parts of P2P, office sharing (office as a service, OaaS), crowdfunding, C2C comprising sales of goods, P2P (rental of goods), freelance, B2B shared facilities and other resources of the companies, etc.

Figure 1. Correlation between digitalization, sustainable development, and collaborative consumption



The sharing economy potential in well-developed and developing countries is maintained by a wide distribution of the internet (in particular mobile internet), increasing competition for customers, absence of intermediaries (e.g., C2C), need for rental, collaborative use, crowd funding services. Growth in the number of city dwellers, high unemployment, financial instability, and expensive credits for the purchase of goods can be considered as reasons for the popularity of the sharing economy practices.

The COVID-19 pandemic and its consequences for the economy (a decrease in entrepreneurial activity, decline in household purchasing power, a change in demand and consumption) highlighted advantages of those areas of sharing economy which are based on joint consumption, since they have the main advantage in comparison with buying a new product - affordability for each individual consumer. At the same time, society makes it possible to reduce the consumption of energy- and resource-intensive goods with long-term environmental effects and to alter the energy mix to favour renewable energy.

Based on the Fisher-Clark theory of structural change, the authors justified the evolution logic of the sharing economy sectors and showed the sequence of their emergence, development, and dominance in gross value added. The results can be seen in Table 4.

Table 4. Transition between the sharing economy sectors in the context of increasing scientific and technological progress and complicating social and economic connections and ties

<table>
<tr><th>Sale of goods between individuals, optimization of personal expenses</th><th colspan="3">Property and labor force rental (mainly in mega-cities)</th><th colspan="2">Economic tools for growth and development within the industry or the territorial economy</th></tr>
<tr><td>Sector 1 - C2C</td><td rowspan="2">Sector 2 – accommodation and goods rentals</td><td rowspan="3">Sector 3 – transportation services</td><td rowspan="4">Sector 4 - P2P services (freelance)</td><td rowspan="4">Sector 5 – Crowdfunding</td><td rowspan="5">Sector 6 - B2B</td></tr>
<tr><td>without intermediaries among the individuals</td></tr>
<tr><td colspan="2">with or without intermediaries among the legal entities and individuals</td></tr>
<tr><td colspan="3">increasing the mobility and accessibility of displacement</td></tr>
<tr><td colspan="4">the sharing city development</td></tr>
<tr><td colspan="5">new investment resource for the economy</td></tr>
<tr><td colspan="6">active involvement of business (according to the connection through the processing chain with a chance to reduce the amount of intermediary consumption) in sharing economy practices</td></tr>
</table>

Source: compiled by the authors

Table 5. Model of sharing economy evolution

Dimensions	Agrarian type of economy (the case of Pakistan)	Industrial type of economy	Service-industrial type of economy	Service-oriented type of economy (the case of the USA)
Rating scale of evolution, points (from 0 to 10)	*0*	*4*	*7*	*10*
1. The spread of the internet (mobile internet)	Barely accessible, high costs	Accessible among the city residents	Alignment of affordability	The widest dissemination, affordable costs
2. Consumers' behavior	Lack of purchasing power	Mass consumption	Adoption of environmentally responsible practices	Environmentally responsible practices and the rise of collaborative consumption
3. Area of employment	in the agricultural sector	in the industrial sector	in the service sector	in the service sector
4. Risk area of collaborative consumption	The illegal sector	Legalization and development of sharing economy forms	Institutionalization of rules and requirements for sharing economy	Risk protection, insurance
5. Most common forms of sharing economy	C2C sales	+ accommodation and goods rental	+ car sharing + carpooling + P2P services (freelance)	+ crowdfunding +B2B

Clark-Fisher's theory asserts that a country evolves through the following stages: agrarian (preindustrial), industrial and postindustrial. Applying this theory the authors investigated the evolution of

sharing economy models in various countries. After analyzing sharing economy sectors a model of the sharing economy evolution was constructed. Table 5 presents this model.

Quantitative Phase

In order to evaluate the results of the influence of factors and risks on the sharing economy development applying the method of structural analysis, the following steps have been taken:

1. The database on the sectoral structure of gross value added has been accumulated and investigated. The database includes the traditional sectoral classification of gross value added into agriculture, hunting, forestry, fishing (ISIC A-B), mining, manufacturing, utilities (ISIC C-E), construction (ISIC F) and service sector including wholesale, retail trade, restaurants and hotels (ISIC G-H), transport, storage and communication (ISIC I) and other activities (ISIC J-P) according to the UN data.

Aggregation the elements of gross value added along the following line:

- agrarian sector (D_A) includes ISIC A-B;
- industrial sector (D_I) includes ISIC C-E;
- service sector (D_S) includes the consecutive elements of gross value added: ISIC G-H, ISIC I and ISIC J-P.

It should be noted that section F "Construction" is not included into any sector, but it helps to develop an additional indicator of the analysis D_G, which accumulates all the goods produced within the national or regional economy.

One condition must be fulfilled: the database should present a 2-year retrospective at least to ensure the objectivity and comparability of data.

Table 6 shows the development indicators of the sharing economy sectors: transportation services, accommodation rental, co-funding, C2C sales, rental of goods, freelance.

2. The data has been systemized into groups. The authors accumulated services into six sectors and identified their development trajectory according to the simplicity or complexity of their mass dissemination, capacity, and efficiency of the services.

If the whole economy is analyzed, the shares of the agrarian, industrial and service sectors should be compared whereas the trend is to the growth of the industry share in comparison with the share of the agrarian sector and to the growth of the service sector in comparison with the industry share. Based on this, the authors propose the following method to estimate the sharing economy,

Two formulas are employed to elaborate the relationship between the sharing economy sectors.

Table 6. Volume development indicators of the sharing economy sectors for 2017-2018

Sharing economy sectors	Unit of measurement	2017		2018	
		A number of the services	Transaction amount, mln. RUB	A number of the services	Transaction amount, mln. RUB
1. Transportation services					
1.1. Car sharing	number of trips, mln. units	12	5100	37	13000
1.2. Car pooling	number of trips, mln. units	24	8100	39	13700
2. Accommodation rental and office sharing					
2.1. Short-term rental	number of visitors, mln. people	1,2	5800	1,6	9800
2.2. Office sharing					
- co-working	-	-	2600	-	3500
- office space (OaaS)	-	-	1700	-	2200
3.Crowdfunding (co-funding)	number of fund-raising campaigns, units	1020	300	1333	400
4.C2C sales	number of transactions, mln. units	90	295000	116	370000
5. Rental of goods	number of transactions, mln. units	25	80	60	180
6. P2P services (freelance)	number of transactions, mln. units	49	73000	64	98000

$$t_{\alpha} = D_I / D_A \quad (1)$$

$$t_{\beta} = D_S / D_I \quad (2)$$

where t_{α} - degree of industrialization which shows how many units of GVA created in the industry account for one unit created in the agricultural sector;

t_{β} – degree of servitization which shows how many units of GVA created in the service sector account for one unit created in the industry.

The authors aggregated the sharing economy sectors presented in Table 4 and in Table 5 into D_i applying the Fisher-Clark theory of structural change and based on the premise that economic development evolves towards the complexity: in this case from the C2C sector to the sector 5 “Co-funding” and 6 “B2B”.

As a result, the following indicator values D_i have been identified:

- D_1 includes only sector 1 - C2C;
- D_2 includes the sectors 2, 3 and 4;
- D_3 includes the sectors 5 and 6.

The relationship between the aggregated sharing economy sectors is a framework for measuring structural ratios of their changes. The formulas (1) and (2) were applied as follows:

$$t_{\alpha} = D_2 / D_1; \quad (3)$$

$$t_{\beta} = D_3 / D_2. \quad (4)$$

Employing the database on the capacity and development of the sharing economy sectors in the Russian Federation for the years 2017 and 2018 (see Table 6), the authors made the necessary calculations (Table 7) and received the following results:

- the highest increase within the aggregated sectors for the years 2017 and 2018 can be seen in the accommodation rental and rental of labor force; the growth of t_{α} is indicative of development trends in the sharing economy of the Russian Federation;
- regarding the prospects of the sharing economy in the coming years and decades the aggregated sector D_3 which includes crowdfunding and B2B (premises and other funds rental among companies) is considered to be the most important and complicated in terms of growth; the received indicator t_{β} shows the necessity to institutionalize rules and conditions of the sharing economy practices particularly with regard to security issues and transparency in transactions.

Table 7. Results of the structural analysis of the sharing economy in the Russian Federation for the years 2017 and 2018

Indicators	*2017*	*2018*	*Interpretation*
D_1 (mln. RUB)	***295000***	***370000***	***The best developed, extensive and core sharing economy sector with a 25,4 per cent growth rate for one year.***
D_2 (mln. RUB.)	***96380***	***140380***	***All the sharing economy rentals are accumulated in this sector.*** **The proportion should be: $D_2 > D_1$** ***The largest growth within this segment was 45,7 per cent for one year.***
D_3 (mln. RUB)	***300***	***400***	***The most economically relevant sharing economy segment. In the sharing economy evolution it must exceed D_2.***
$t_{\alpha} = D_2 / D_1$	***0,33***	***0,38***	**Normative value: $t_{\alpha} > 1$** **t_{α} has grown by 16,1 per cent**
$t_{\beta} = D_3 / D_2$	***0,00311***	***0,00285***	**Normative value: $t_{\beta} > 1$** **t_{β} has decreased by 8,5 per cent**

According to the calculated indicators t_{α} и t_{β} for the period of time which makes it possible to analyze and evaluate trends, a graphic field can be built to investigate a national economy or several national economies with the aim to compare them. The evolution vector for the analyzed period is evaluated empirically and the quality of changes within a national economy or in its regions or cities analyzed.

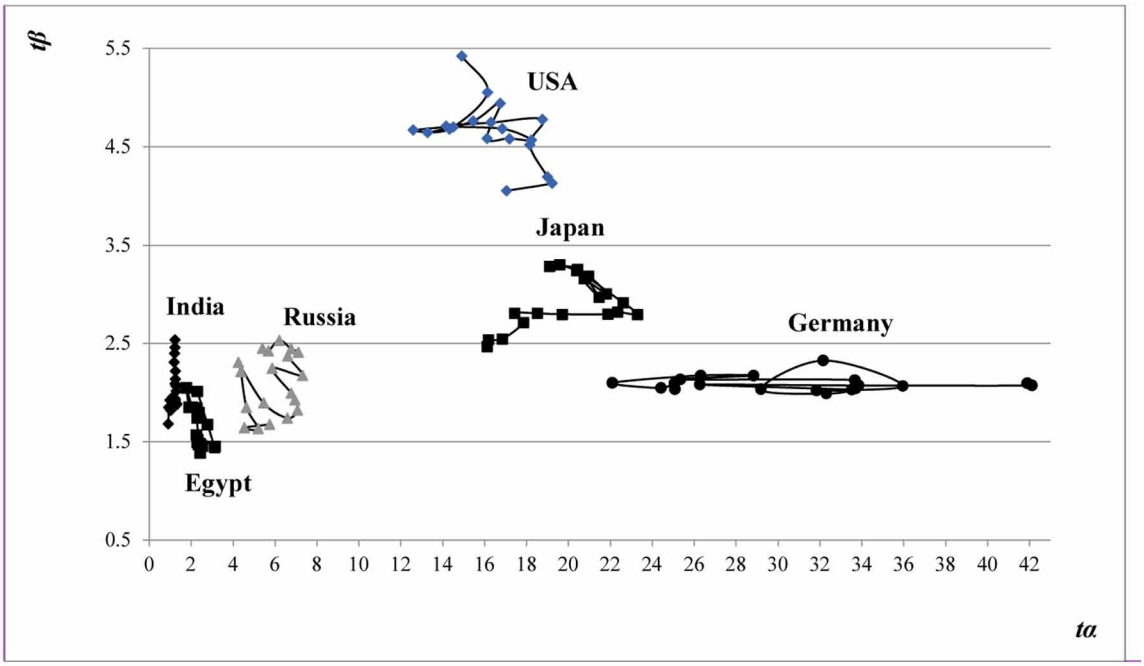
The authors of the study conclude that the more the indicators t_{α} и t_{β} exceed 1, the more developed the economy can be considered according to its structural changes for the analyzed period. Consequently, it can be characterized as the economy with well-developed industrial and service sectors.

Based on the UN data, the authors made calculations by the formulas (1) and (2) and received the following results of structural changes within national economies (see Figure 2). To receive the most representative and illustrative results, the authors selected countries with different levels of development: India, Egypt, Russia, the USA, Japan, and Germany.

The sampled countries were selected according to the following criteria:

1. geography (different climatic conditions, different culture including consumption culture);
2. different levels of technological and socio-economic development which affects the availability, demand, and attractiveness of sharing economy for business and investors;
3. different risks and opportunities for the sharing economy development dependent on such sectors of the national economy as construction, agriculture, etc.

Figure 2. Graphic field of correlation between t_α and t_β within the national economies
Source: compiled by the authors based on the method of the structural analysis according to the United Nations data «Gross value added (GVA) by kind of economic activity at current basic prices».



Based on the received data, it is possible to mark more points on the graph, but there is a limitation related to a lack of data on the structure and dynamics of the sharing economy in different countries. The interpretation of the graph will be identical to the presented in Figure 4 correlation field.

The calculations of the structural analysis indicators allow to identify an exact development vector for the sharing economy and to justify the need for developing a digital, legal and ideological base to ensure the increase in the rate of evolution according to the target vector: to the growth of aggregated shares of D_2 and D_3 in comparison with D_1.

Table 8. Territories ranked according to the disparity of the integral ranks on the scale from 0 to 200

Countries					.....											
Normalized values	0,000	0,070	0,153	0,167		1,835	1,863	2,044	2,127	2,197	2,239	2,308	2,392	2,614	3,115	3,170
Ratio x_i to x_{max}	0	0,022	0,048	0,053		0,579	0,588	0,645	0,671	0,693	0,706	0,728	0,754	0,825	0,982	1
Rank with the variations on the scale from 0 to 200	0	4	10	11		116	118	129	134	139	141	146	151	165	196	200

The authors compared each sector of sharing economy with the previous one and found out that the proportion of sharing economy in the overall economic activity at the current stage must be greater than at the previous stage: $D_3 > D_2 > D_1$. In practice, this proportion does not always work. However, it makes possible to distinguish the development level of the sharing economy in different countries. If the condition is met, the country can be considered well-developed. If the condition is not met, the country is indicated as less developed.

The rank analysis method can be employed in two versions:

1. The mathematical version is based on the method of effective rank developed by the authors and includes the following algorithm.

The current practice of ordinal rate values ranking does not take into account the difference in levels of development between the regional economies. The proposed method developed by the authors takes into consideration the non-linearity of ranked set units distribution. It makes it possible to measure a difference degree between the units which are close to each other in the rank distribution.

The proposed method includes building a linear model of normalization with the closed ranking scale and calculation of "effective rank" as a modeled linear rank distribution with the open scale.

According to the macroeconomic performance, all the countries can be divided into three types:

the countries having the lowest (I type) and the largest (III type) values, the countries which have intermediate values between the minimum and maximum values belong to the II type. The majority of countries relate to the II type and have a linear trajectory.

The rank value for each territory is determined on the base of levelling out extreme derivations and the basic formula $\tilde{\blacklozenge} = \frac{\blacklozenge_i - x_{\min}}{x_{\max} - x_{\min}}$ provided that the rank as an integer is f(x), wherein a linear model of normalization is proposed which provides the ranking opportunity not only to renumber the ranking units from 1 to any number in accordance with a number of regions but also to measure a variation of their location considering their disparity according to the achieved development indicators.

As a result, the formula identifying normalized values for each region is converted as follows:

$$\tilde{\blacklozenge} = \frac{\blacklozenge_i - x_{\min(alongthetrend)}}{x_{\max(alongthetrend)} - x_{\min(alongthetrend)}}, \quad (5)$$

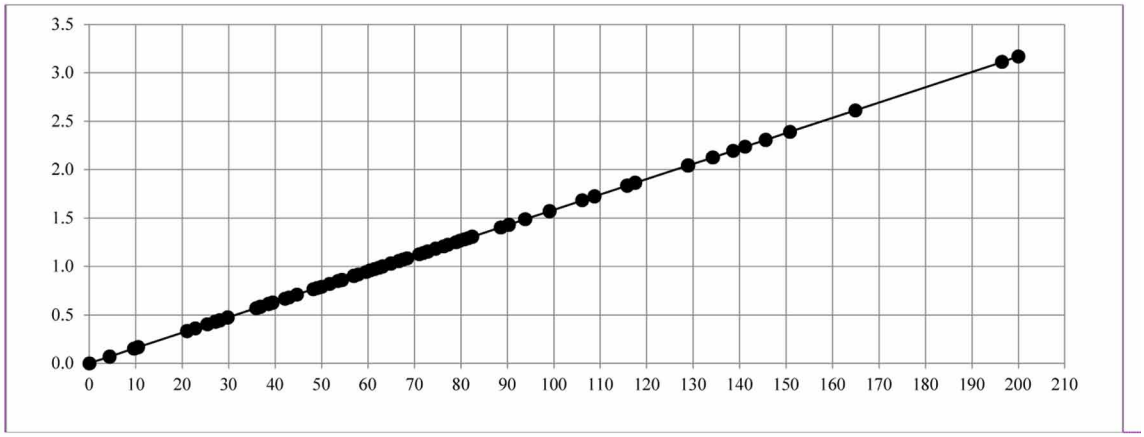
where $x_{min(along\ the\ trend)}$ and $x_{max(along\ the\ trend)}$ are minimum and maximum values determined by the linear trend formula.

It is recommended to take into consideration the discrepancy between the values $\tilde{\hat{}}_i$ in order to transform the ranked values into integers and build a regions distribution. Then the ranks attributed to the countries according to their place in the range of normalized values will have wide variations among each other and reflect their real place.

For instance, the minimum rank is 0, the maximum rank is 200. The normalized values $\tilde{\hat{}}_i$ are transformed into integers (see Table 8).

Figure 3 shows territories distribution with variations allowing to see the difference between the achieved results in the development.

Figure 3. Example of a territories distribution model on the rank scale from 0 to 200



However, the presented method retains a limit rank value in the number of 200 and does not allow to make an evaluation of the changing slope of a curve if the degree of nonlinearity in regions distribution according to the selected indicator of development is changing.

To address this gap the authors present the second variant of rank distribution.

1) A scope of variation is calculated: $R = x_{\max} - x_{\min}$; (6)
2) A linear rank distribution is modelled: $LRD = x_{\min} + (i-1) * h$ (7)

where *i*= 1,…, n – rank *r* of the rank unit (regions, countries);

h= *R*/ (n-1).

3) The isomorphic mapping of the nonlinear structure of values for the selected indicator ranked according to the appropriate structure of positive integers is built:

$$Y = k \times r + a_0 \tag{8}$$

where Y – indicator of social economic territory development;
k –linear coefficient;
r – rank of the region;
a_0 – absolute term.

4) By substituting empirical values of rank indicator instead of Y to the presented equation and by solving it according to the rank r, we have the following expression:

$$r = \text{int}\, eger[\frac{y - a_0}{k}] \tag{9}$$

where integer (argument) is a function rounding off its argument to the closest smallest integer value.

5) the formula (8) is transformed to the formula for the calculation of the effective rank r*, where parameters of the equation of straight line calculated along a linear segment are substituted instead of k and $a_{0.}$
6) An additional procedure for building effective rank values for all the rank units is a displacement of maximum rank to the value 1.

Rank calculation on one indicator in the dynamics allows estimating the results of changing its values over time and evaluation of the results according to the changing slope of a curve and its approach to X or Y axis.

After applying the method of effective rank for ranking the national economies according to the level of their economic development, the authors came to the following conclusion:

- the more an indicator is controlled by government, the smaller is its variability;
- the more the rank value depends on the cost of labor resources, accessibility of resources and highly developed technology, the stronger is oscillation amplitude of rank values and in the overall rating.

Qualitative Phase

The authors employed a qualitative method (expert analysis) to obtain additional information concerning factors, risks, and prospects of the sharing economy. A descriptive evaluation of the sharing economy factors, risks, and prospects by means of structured interviews with experts participating in the sharing economy businesses (start-up leaders, platform developers, sharing economy project leaders) and government officials responsible for digital economy implementation in the cities of Russia has been conducted.

The content section of the interview protocol comprised four blocks: the most developed sharing economy sectors, factors affecting the sharing economy, obstacles and risks that might slow down the

sharing economy, proposals to solve these problems. This part of the study is presenting analysis of answers and inputs provided by survey respondents.

Table 9. The most developed sharing economy sectors in Russia

Sharing economy sector	A number of experts selecting the sector
Accommodation rental	12
Office sharing, co-working	11
B2B	8
P2P	7
Carpooling	6

The above data in Table 9 are basically consistent with the findings of the structural and rank analysis. The experts consider accommodation rental, office sharing, B2B, P2P and carpooling to be the most developed sharing economy sectors in Russia.

To find out factors affecting the sharing economy, the respondents were offered to select the factors from the list and to propose their own variants (See Table 10).

Table 10. Factors affecting the sharing economy

Factors selected from the list
1. Digital economy development 2. Openness of citizens and businesses to innovations 3. Consumer mentality affecting behavior patterns 4. Political situation in the country
Factors offered by the respondents
1. Regulatory at the national and local levels 2. Availability of the services 3. Simplicity and quality of the infrastructure 4. Digital literacy of the users 5. Trust

One of the aims of the study was to identify problems and risks impeding the development of the sharing economy. Most of the respondents indicated the same obstacles and gave expanded comments.

1. Lack of regulatory framework

The respondents gave the following comments.

"Lack of legal framework makes it possible to break the law and to provide low-quality services".

"It can cause tax evasion. We can see this situation in Russia which is resulting in losses to local budgets".

2. Trust between the sharing economy users

"Most of the consumers do not have trust towards sharing economy businesses; they would prefer to use traditional services because they think they will be deceived".

"As there were several cases of fraud and crime, people prefer to avoid sharing economy services".

3. Protection of personal data

"People can become victims of fraudsters and lose their money".

"Hackers all over the world are hunting the data which they can use for their purposes."

The respondents proposed some areas for improvement in this field.

1. "Governments should contribute to the sharing economy development by providing the infrastructure and creation of legal framework; in exchange, they receive an increase in self-employment, new units of taxation, growth in the quality of life".
2. "To increase safety and prevent losses from various cases of fraud, an integrated digital business platform should be established; registration and authorization on the platform should be mandatory for all the digital economy participants including sharing economy users who will come through the procedure of listing to confirm their legitimacy and solvency; this platform can be similar to integrated digital state platforms which exist in several countries and where all the online-resources of the government are concentrated and online-services are provided".
3. "Inflicting penalties for low-quality services and tax evasion".
4. "The sharing economy users should bring together to address emerging challenges".

FUTURE RESEARCH DIRECTIONS

The findings of the presented study can be used to develop measures for improvement of the sharing economy practices. Further study can involve experts from other countries to find out their opinions towards the sharing economy factors and prospects.

CONCLUSION

Applying the method of the structural and rank analysis developed by the authors, typology of countries according to their digitalization and development of sharing economy has been constructed. An "interactive map" can be created with the countries visualized on the map according to the development of the service sector (including non-material services) based on the method of the structural and rank analysis.

In order to obtain more accurate and detailed results, it is necessary to increase the availability of the United Nations databases on the sharing economy.

Summarizing on the obtained findings we can make the following conclusions.

Sharing economy practices can be considered as a real way to diminish the negative impact of the global environmental crisis because it leads to cost savings through the redistribution of wealth.

The level of the sharing economy development in different countries can be measured by the method of structural and rank analysis developed by the authors, it can be presented as a new approach to the typology of countries according to the development of digitalization and sharing economy.

Factors and risks affecting the sharing economy at the national level have been identified. The authors employed two methods to identify factors and received similar results.

The research outcomes may be used by governments to build a cooperative sharing economy framework.

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