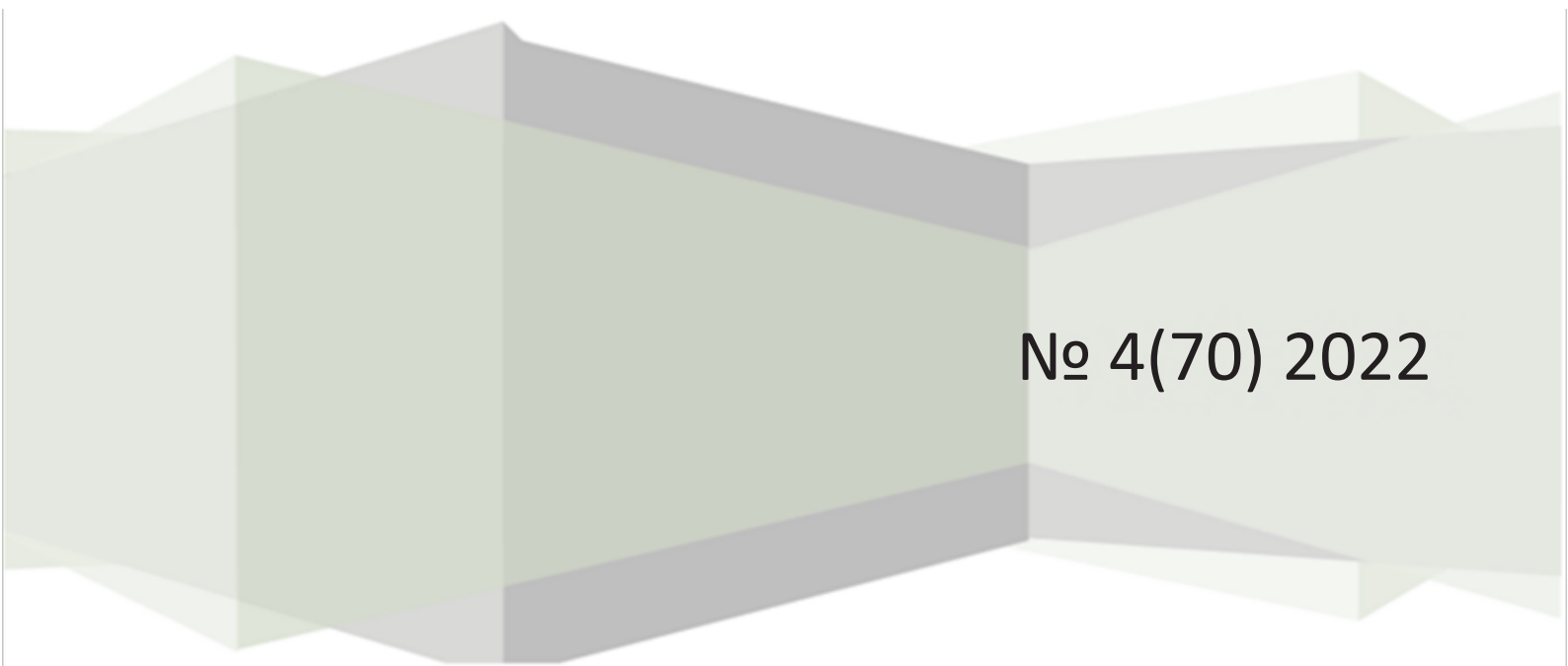# Components of Scientific and Technological Progress

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Model for the Quality Assessment Process of the Research Support System

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Key words and phrases: quality management; research activities; research support system; software quality assessment; software quality.

Abstract. The development and creation of hardware and software systems for ensuring processes of support of research activity of the knowledge-intensive enterprises is important aspect of development of infrastructure of scientific, technical and innovative activities. Today, in the context of the growing demand of consumers for this type of software systems, there is an active development and complication of software products under the changing requirements of users. In this regard, the issue of assessing their quality is becoming more and more urgent. The article researches the approach to quality assessment of the research support system, presents the model of quality assessment, and identifies the advantages and limitations of its application.

Introduction

The development of a system of scientific, research and design organizations for the modernization of the economy in the Russian Federation is one of the most important national goals declared at the state level. To achieve this goal, a number of national projects and programs are being implemented, including the "Strategy for the development of the information society in the Russian Federation for 2017–2030", "National Security Strategy of the Russian Federation", national projects "Digital Economy", "Science", "Education", etc. According to the documents of one of the major tasks stated above there is a development of infrastructure of scientific, scientific and technical and innovative activity.

The performance of both scientific organizations and individual researchers can be assessed by the results of their work, which are expressed in the creation of intellectual property objects such as scientific articles, monographs, patents, etc.

Given the existing policy of increasing the number of publications, the task of correctly recording and processing information about them becomes relevant for organizations engaged in research and development.

This task is accomplished by specialized software and hardware complexes – the systems for supporting research activities.

To date, a fairly large number of such products are represented on the software market,
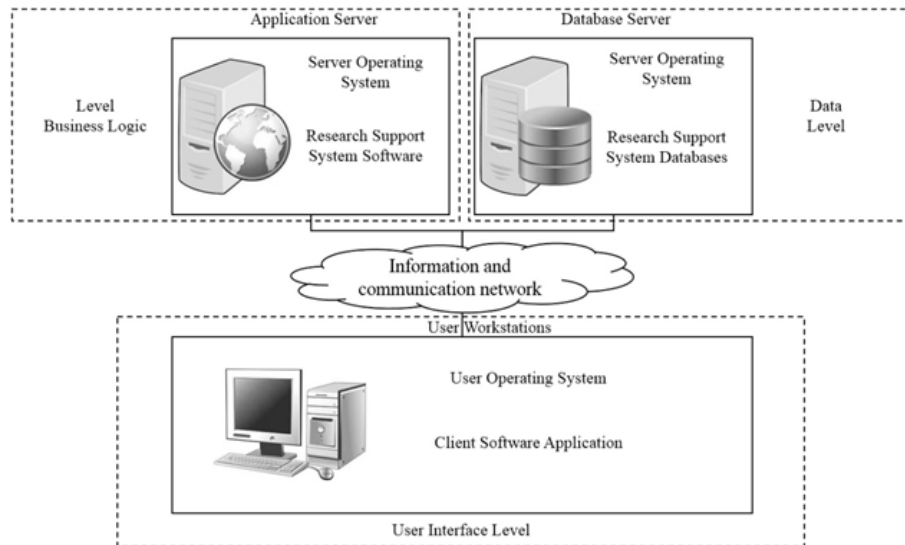
Fig. 1. Research support system architecture

but there are no methods to improve their quality based on the creation of scientific and methodological tools to improve their performance, taking into account the requirements of consumers and other interested parties.

Functionality and architecture of research support

Software and hardware (information systems) supporting research activities are one of the elements of the infrastructure of scientific research and development. They are designed to automate accounting and analytical functions, the functions of planning, monitoring and management of research activities, and also serve to consolidate science-metric data on the performance of scientific personnel [1].

The introduction of research support systems in the activities of knowledge-intensive enterprises leads to a whole range of positive effects.
– Increasing the efficiency of research activities in the organization.
– Increased transparency and manageability of R&D processes.
– Reduced time to prepare various forms of reports and analytical documents.
– Redundancy and heterogeneity of R&D document flow is reduced.
– Reduced labor costs to support R&D information support processes.
– The process of monitoring the use of withholding tax results is simplified.

The functionality of these systems is quite wide and allows you to solve a number of important tasks that are faced by knowledge-intensive enterprises. An analysis of article [2] showed that such tasks include:
– automating the accounting of research results;
– unification of the procedure for entering information on intellectual property objects;
– standardization of stored data;
– simplicity and ease of access to information through various search queries;
– scientific research management;
– research planning;
– generation of various forms of reports;

- analysis and forecasting of research results;
- accounting and ensuring legal protection of intellectual property objects;
- accounting for the use of intellectual property;
- monitoring of R&D objectives, etc.

Research support systems (**RSS**) are complex systems that include such elements as software, hardware, information and communication network and personnel responsible for operation and maintenance. All elements are interdependent and make up the architecture of the system. The system architecture is schematically shown in Fig. 1.

Both Russian and foreign researchers study the specifics of development and design of research support systems and their functioning.

The analysis of approaches to the design and development of research support systems has shown that both bottom-up and top-down methods of building an automated information system are used for these purposes. It should be understood that the design method will largely determine the life cycle (**LCC**) model of the software system under development. In turn, the lifecycle model will determine the structure of a comprehensive quality indicator for the software development process [3].

In the domestic software market in recent years, there has been an increasing demand for research support systems, while there is a constant complication and development of software products for the needs of users. At the same time, the number of development companies is also increasing, which creates tighter competition in the market. Obviously, the most successful companies will be able to meet the needs of users as much as possible, as a result of this, the task of improving the performance of these systems becomes relevant, which in turn will require the development of scientific and methodological tools to improve their quality, taking into account the requirements of consumers and other interested parties.

Assessment of the quality of the research support system

The quality of research support systems is a comprehensive measure of the extent to which users' needs are met according to their purpose. The quality of research support systems on the one hand is determined by the quality of their development processes, and on the other hand includes the quality of the product itself.

The quality of software depends to a large extent on the maturity of the system in which it is developed, that is, on the maturity of the organization and the standardization of its processes.

Research support systems are an independent type of software and information products, and the quality management of these systems is carried out on the basis of the use of certain tools and is regulated by the corresponding regulatory and technical base.

To date, there are more than 160 international and national standards in the field of software and information systems quality assurance and management, more than 45 structural and functional models of software quality [4; 5], as well as other mathematical models of programmetrics designed for quantitative analysis of various parameters of characteristics and sub-characteristics of software quality. At the same time, it should be noted that many of the approaches considered for assessing the quality of software and hardware complexes are either quite general or redundant, and their applicability to quality management of research support systems requires refinement and adaptation.

To develop a methodology for assessing the quality of research support systems, a functional model of the quality assessment process was developed, as well as a generalized algorithm for actions.
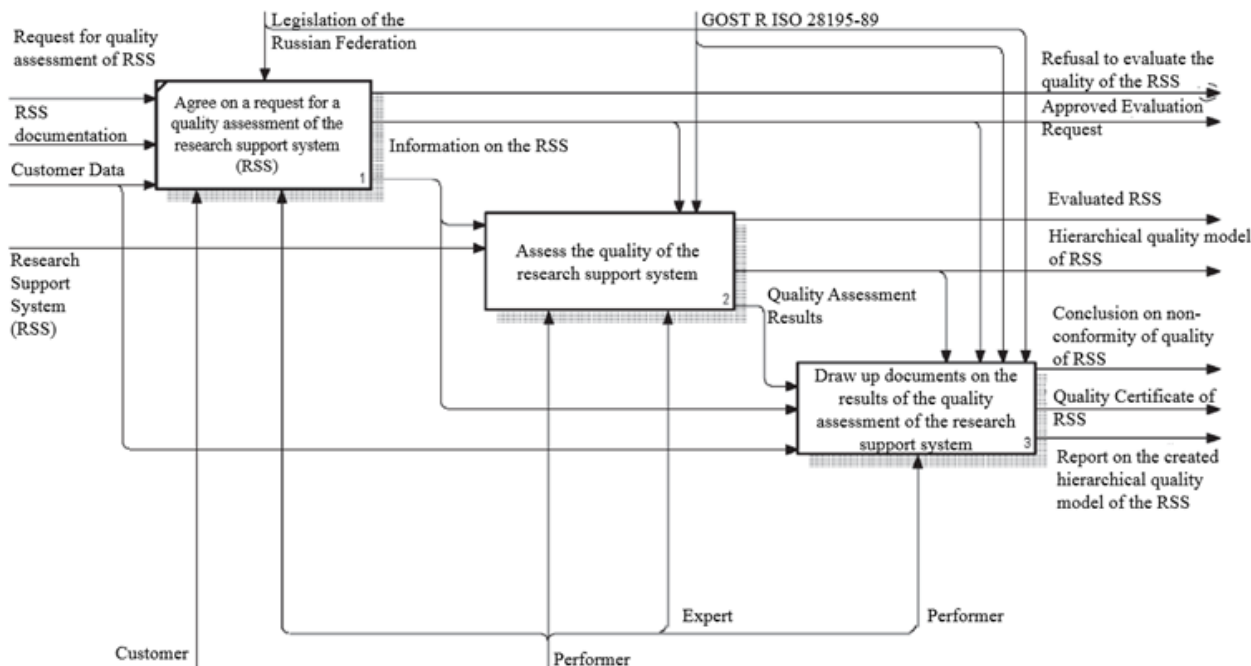
Fig. 2. Functional model of the quality assessment process of the research support system

In accordance with this model, the process of assessing the quality of research support systems is decomposed into three main blocks:
– approval of the application for system quality assessment;
– assessment of the quality of the research support system;
– preparation of documents that will provide information on the results of the assessment of the quality of the research support system.

A model of the quality assessment process of the research support system is presented in Fig. 2.

The function of conducting quality assessment of research support systems includes six steps:
– definition of the purpose, type and life cycle phases of the RSS to be evaluated;
– definition of planned requirements for the quality of the RSS;
– preparation for the assessment of the quality of the RSS;
– assessment of the quality of the RSS;
– quality control of the RSS;
– conclusion on ensuring the required level of quality of the RSS to be evaluated.

The preparation process for the quality assessment of research support systems includes the following three activities:
– selection of quality metrics of research support systems;
– definition of evaluation methods and scales;
– establish rating levels for metrics.

The function of conducting quality assessment of the research support system is decomposed into the following actions:
– values of single indicators are established by expert or measuring method, calculations for evaluation elements are carried out;
– relative and absolute quality indicators of the research support system are calculated,
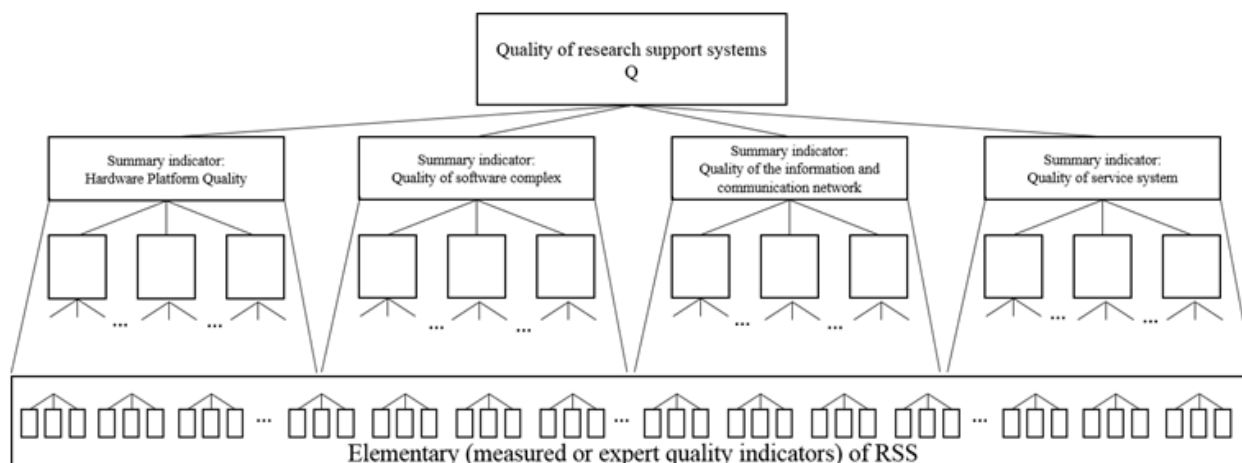
Fig. 3. Summary structure of the network of quality indicators of the research support system

which are aggregated into a summary indicator of the system quality level;

– a model of the quality of the evaluated research support system is created, having a hierarchical structure.

Documentation of the results of the quality assessment of the research support system consists of the following functions:

– issuance of the quality certificate of the evaluated research support system;

– preparation of a conclusion on non-conformity of the quality of the evaluated research support system with the required level of assessment;

– preparation of a report on the created hierarchical quality model of the evaluated research support system.

According to the considered model, the quality assessment is carried out at all stages of the life cycle of the system, including both the design and development stages of the system and the stage of its operation. The quality assessment is carried out by the method of aggregation of aggregate quality indicators, which is a convolution of the final set of single-level private indicators of the quality assessment network of the research support system. The summary structure of the network of quality indicators of the research support system is presented in Fig. 3.

In general, the mathematical form of the quality function of the research support system can be described as:

$$Q = f(q_1(b_1), q_2(b_2), \ldots, q_i(b_i), \ldots, q_n(b_n)),$$

where Q is the value of the summary quality assessment indicator of the research support system according to the summary indicator; $q_i(b_i)$ is the value of the quality assessment of the research support system according to the i-th elementary indicator b_i, $i = (\overline{1, n})$; n is the number of elementary quality indicators.

If the mathematical condition of existence and continuity is met, the measure Q can be represented in the normal form:

$$Q = \sum_{i=1}^{n} q_i(B),$$

where $B = (B_1, B_2, \ldots, B_i)$ is a vector that includes the first i of n elementary indicators.

If the preference independence condition is met, then the Q index has the additive form:

$$Q = \sum_{i=1}^{n} q_i b_i.$$

The multiplier form of the summary measure of the quality of the research support system will be:

$$Q = \prod_{i=1}^{n} q_i b_i.$$

At the same time, it should be borne in mind that in the integral assessment of the quality of the research support system, weights are also introduced that allow you to determine the significance of individual characteristics and object characteristics for quality as a whole. Weights are determined by an expert method. The weight of the local indicator is denoted – v, the conditions must be met $v \in (0, 1)$, $v \in R$ and $\sum v = 1$.

Conclusion

The study showed that the method under consideration correctly aggregates any number of private quality indicators and at the same time takes into account their significance for the higher level indicator.

This approach has a number of advantages, including the relative ease of computation and the understandability of the hierarchical structure of quality indicators, as well as the applicability at any stage of the life cycle of the research support system. The usability of the described quality assessment model at the operation stage is due to the formed system of quality requirements and an established nomenclature of indicators, which allows you to build a quality audit plan. However, it is not devoid of shortcomings: it requires a sufficiently large time spent, depends on the consistency, objectivity and qualifications of the experts involved in the assessment, and is also performed at discrete points in time to evaluate the discrete states of the system.

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Модель процесса оценки качества системы поддержки научно-исследовательской деятельности

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Ключевые слова и фразы: качество программного обеспечения; научно-исследовательская деятельность; оценка качества программных средств; система поддержки научно-исследовательской деятельности; управление качеством.

Аннотация. Разработка и создание программно-аппаратных комплексов для обеспечения процессов поддержки научно-исследовательской деятельности наукоемких предприятий является важным аспектом развития инфраструктуры научной, научно-технической и инновационной деятельности. На сегодняшний день в условиях возрастающего спроса потребителей на данный вид программных систем происходит активное развитие и усложнение программных продуктов под изменяющиеся требования пользователей. В связи с этим становится все более актуальным вопрос оценки их качества. В статье проведено исследование подхода к оценке качества системы поддержки научно-исследовательской деятельности, представлена модель оценки качества, а также определены преимущества и ограничения ее применения.

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Framework of Technology for Consumption of Natural Resources in Urbanized Territory

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Key words and phrases: consumption; city; efficiency of environmental protection measures; environment; indicator; industrial enterprises; negative impact; technology.

Abstract. Sustainable development of populated areas involves the efficient use of natural resources. Research objectives: based on a review of the state of natural components of the environment, to develop a matrix of technology for their rational consumption. The working hypothesis lies in the assumption that at the stages of the life cycle of consumption of one or another natural component there is a great potential for the efficiency of its use, and a breakthrough to a new progressive level is possible at any part of the organizational and technological chain of economic activity. The method of system analysis was used. The result is a developed schematic diagram with a description of the elements of the structure of the technology of consumption of natural resources in an urbanized territory.

Urbanization of the territory entails an increase in loads caused by the density and resource intensity of economic activity [1; 2]. The technology of consumption of a particular natural resource is a complex system of knowledge of a set of processes for ensuring environmental safety, rational use and protection of natural components of the environment [3; 4]. Green spaces become compensation for the damage caused to air, water or soil during the production and consumption of goods, products and services [5; 6].

Analyzing the composition of the processes for ensuring environmental safety, the use and protection of natural components of the environment, two main groups can be established: material and information. Material processes are processes of nature management, which cover a set of actions aimed at material elements when using a natural resource, and are part of consumption technology. Information processes are implemented using information technologies in order to develop and make decisions on the most rational implementation of consumption technology.

Under the structure we understand the totality of stable connections of the object, ensuring its integrity and identity to itself, that is, the preservation of the main properties during various external and internal changes. The structure of the system is the organization of connections and relationships between subsystems and elements of the system, as well as the composition of these subsystems and elements, each of which usually corresponds to a specific function.
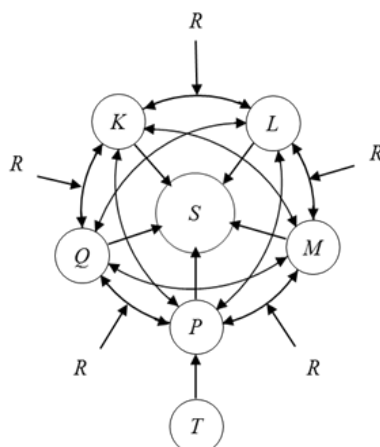
Fig. 1. Scheme of the structure of technology for consumption natural resources

In general, the structure of the natural resource consumption technology includes the following elements: the process of natural resource consumption (P), technical means (M), labor resources (Q), material elements (L), natural resource (K), which together form an interdependent system that is influenced by time (T) and environment (R) factors (figure).

To ensure environmental safety, use and protection of the natural components of the urban environment, an appropriate process of natural resource consumption should be formed, which has a certain sequence of simple processes and operations included in it. The set of parameters characterizing the process of consumption of a natural resource will be denoted by $P = \{P_1, P_2, \ldots, P_i\}$ and set for the value of each i-th parameter the requirements of optimal matching $P_i \in P_n$.

The process of consumption of a natural resource is implemented using one technical means and (or) from sets formed from them. The set of parameters related to technical means will be denoted by $M = \{M_1, M_2, \ldots, M_i\}$ and set the range to the requirements of their rational choice $M_i \in M_n$.

A purposeful sequence of actions to implement the process as a whole and its constituent simple processes and operations is carried out by individuals with the appropriate competencies. Let us designate the set of parameters characterizing labor resources as the set $Q = \{Q_1, Q_2, \ldots, Q_i\}$ and set limits on requirements for performers of operations and processes $Q_i \in Q_n$.

The process of consuming a natural resource must be provided with material elements. The set of characteristics and parameters of the necessary materials will be denoted as a set $L = \{L_1, L_2, \ldots, L_i\}$, where each value of the i-th parameter satisfies the rational choice condition $L_i \in L_n$.

The set of parameters and characteristics that determine the state of a natural resource will be denoted by $K = \{K_1, K_2, \ldots, K_i\}$, by setting safe values of i-th parameters $K_i \in K_n$.

The more correctly the parameters of individual elements of the natural resource consumption technology are determined, the closer the correspondence of one element to another, the higher the efficiency indicators of the natural resource consumption process: $Э = \{Э_1, Э_2, \ldots Э_i\}$, including the volume of its natural state, the level of pollution, the duration of restoration, capital and current costs for rational nature management and protection.

The urban ecosystem, in which one or another technology of natural resource consumption is used, is characterized by a group of parameters and factors, including the historically

Table 1. The composition of the technology of consumption for components of the natural environment

Name of elements	Designation of elements							
	P	M	Q	L	K	$Э$	R	T
A. Atmospheric air								
*A.*1. Stationary source	$P_{A.1}$	$M_{A.1}$	$Q_{A.1}$	$L_{A.1}$	$K_{A.1}$	$Э_{A.1}$	$R_{A.1}$	$T_{A.1}$
*A.*2. Mobile source	$P_{A.2}$	$M_{A.2}$	$Q_{A.2}$	$L_{A.2}$	$K_{A.2}$	$Э_{A.2}$	$R_{A.2}$	$T_{A.2}$
*A.*3. Ozone layer of the atmosphere	$P_{A.3}$	$M_{A.3}$	$Q_{A.3}$	$L_{A.3}$	$K_{A.3}$	$Э_{A.3}$	$R_{A.3}$	$T_{A.3}$
*A.*4. Near-Earth space	$P_{A.4}$	$M_{A.4}$	$Q_{A.4}$	$L_{A.4}$	$K_{A.4}$	$Э_{A.4}$	$R_{A.4}$	$T_{A.4}$
W. Water								
*W.*1. Water object	$P_{W.1}$	$M_{W.1}$	$Q_{W.1}$	$L_{W.1}$	$K_{W.1}$	$Э_{W.1}$	$R_{W.1}$	$T_{W.1}$
*W.*2. Extraction and purification of water	$P_{W.2}$	$M_{W.2}$	$Q_{W.2}$	$L_{W.2}$	$K_{W.2}$	$Э_{W.2}$	$R_{W.2}$	$T_{W.2}$
*W.*3. Transportation of water	$P_{W.3}$	$M_{W.3}$	$Q_{W.3}$	$L_{W.3}$	$K_{W.3}$	$Э_{W.3}$	$R_{W.3}$	$T_{W.3}$
*W.*4. Use of water by the consumer	$P_{W.4}$	$M_{W.4}$	$Q_{W.4}$	$L_{W.4}$	$K_{W.4}$	$Э_{W.4}$	$R_{W.4}$	$T_{W.4}$
*W.*5. Wastewater treatment	$P_{W.5}$	$M_{W.5}$	$Q_{W.5}$	$L_{W.5}$	$K_{W.5}$	$Э_{W.5}$	$R_{W.5}$	$T_{W.5}$
*W.*6. Returning water to a natural source	$P_{W.6}$	$M_{W.6}$	$Q_{W.6}$	$L_{W.6}$	$K_{W.6}$	$Э_{W.6}$	$R_{W.6}$	$T_{W.6}$
S. Soil								
*S.*1. Research	$P_{S.1}$	$M_{S.1}$	$Q_{S.1}$	$L_{S.1}$	$K_{S.1}$	$Э_{S.1}$	$R_{S.1}$	$T_{S.1}$
*S.*2. Recovery	$P_{S.2}$	$M_{S.2}$	$Q_{S.2}$	$L_{S.2}$	$K_{S.2}$	$Э_{S.2}$	$R_{S.2}$	$T_{S.2}$
*S.*3. Rehabilitation	$P_{S.3}$	$M_{S.3}$	$Q_{S.3}$	$L_{S.3}$	$K_{S.3}$	$Э_{S.3}$	$R_{S.3}$	$T_{S.3}$
GF. Green fund								
*F.*1 Plant	$P_{F.1}$	$M_{F.1}$	$Q_{F.1}$	$L_{F.1}$	$K_{F.1}$	$Э_{F.1}$	$R_{F.1}$	$T_{F.1}$
*F.*2. Utilization	$P_{F.2}$	$M_{F.2}$	$Q_{F.2}$	$L_{F.2}$	$K_{F.2}$	$Э_{F.2}$	$R_{F.2}$	$T_{F.2}$
*F.*3. Liquidation	$P_{F.3}$	$M_{F.3}$	$Q_{F.3}$	$L_{F.3}$	$K_{F.3}$	$Э_{F.3}$	$R_{F.3}$	$T_{F.3}$

established specifics of economic activity, production and consumption, natural-climatic, organizational-technological and socio-economic conditions. The set of influencing conditions will be denoted by $R = \{R_1, R_2, …, R_i\}$, given that the value of the *i*-th impact is controlled by its compliance with the acceptable minimum $R_i \in R_n$.

The process of consumption of a natural resource is inseparable from time. The scheduling of a process makes it possible to take into account the interconnection of the simple processes and operations included in it, their interaction with each other and the environment. The set of parameters characterizing the time of the natural resource consumption process will be denoted as $T = \{T_1, T_2, …, T_i\}$ given that the value of the *i*-th time parameter is regulated by the correspondence $T_i \in T_n$.

The composition of the technology of water and air consumption, land use and the provision of urbanized territory with green spaces in the conditions of the urban ecosystem can be described in the form of a matrix (table 1).

The presented structure is important for understanding the totality of technological, organizational, managerial and economic relationships between the elements of natural resource consumption technology, their differences and commonality. Increasing the efficiency of decision makers at all stages of the life cycle of consumption of urban natural resources ensures the

preservation of their sustainable state.

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Структура и состав технологии потребления природного ресурса на урбанизированной территории

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Ключевые слова и фразы: город; индикатор; негативное влияние; окружающая среда; потребление; технология; экологический ущерб; эффективность природоохранных мероприятий.

Аннотация. Устойчивое развитие населенных мест предполагает эффективное использование природных ресурсов. Задачи исследования: на основе обзора состояния природных компонентов окружающей среды разработать структуру и состав технологии их рационального потребления. Рабочая гипотеза заключается в предположении, что на этапах жизненного цикла потребления того или иного природного компонента скрыт большой потенциал эффективности его использования, а прорыв на новый прогрессивный уровень возможен на любом участке организационно-технологической цепи хозяйственной деятельности. В работе использован метод системного анализа. Результатом исследования является разработанная принципиальная схема с описанием элементов структуры технологии потребления природных ресурсов на урбанизированной территории.

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The Evolution of Museum Space
in the 20th Century

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Key words and phrases: architecture; gallery; history; museum; space.

Abstract. The study aims to collect information about the prominent representatives of museum architecture of the 20th century and to analyze trends in the architecture, function, features of museum buildings of different periods. The research objectives are to show the processes of changing the attitude of a person to the museum, using the example of several prominent representatives of the architecture of museums of the 20th century; to show how changes in society influenced the evolution of the museum, how the depth of attitude towards history affects the fundamental form of the museum. The research hypothesis is the assumption that the museum evolves along with society. By the end of the 20th century, the museum had turned from an elite and aristocratic object of history into an entertainment industry, taking on many forms, from traditionally expensive and complex to new, democratic, popular ones. The study considered the most prominent representatives of the main types of museums of the 20th century and outlined the features and the patterns of their development, and traced the process of democratization of the museum as an institution.

Introduction

Over the last 100 years, the museum has gone a long way from a classical palace-museum to a democratic open-air museum. The museum, as a mirror of society, reflects the processes of democratization and deformalization of attitudes towards history. The museum began its history in the early twentieth century as an expensive collection of works of art through large state museums of classical art of the middle of the twentieth century, but at the end of the twentieth century, it disintegrated into all the variety of different types of museums from supermuseums, as temples of money, to youth initiatives.

The research problem is the lack of understanding of the patterns and sequence of development of a modern museum in the 20th – early 21st centuries. The study investigates large and most characteristic museums in Europe, Russia and the United States of certain

Fig. 1. Museum art and industrial academy of A.L. Stieglitz

patterns of change in the status and role of a museum in the life of a person and society.

Earliest examples of museums

The most striking and earliest museum of the early twentieth century is the private museum of the collection of fine art of the Art Academy of Baron Stieglitz (Fig. 1). Despite the fact that this is a purely private collection, created with personal savings, the museum here plays a charitable role of edifying and educating Youth. The museum plays here the role of a cultural layer, which must educate and create a new generation of artists. The museum was founded in 1878, but the building itself was built by the architect Mesmakher in 1898. This is one of the first buildings built specifically for the museum. Many museums have historically sprung up in palaces after the death of their owners.

Types of museums

The museums of 20th century can be divided into several types:

1) a classical museum (Hermitage, Tate, British Museum): a classic building used for a permanent exhibition of highly recognized art;

2) a museum as a work of modern architecture (Guggenheim, Kiasma, Glasgow): an ultra-modern building as a manifesto, serving as a cultural attractor of a place in which the content and quality of art plays a secondary role;

3) a museum of one historical person (Museums of Bulgakov, Pushkin, Rodin, Dostoevsky);

4) a museum-installation / a museum-performance (Vitra, Monino, Chernousovo): a significant open-air area as a cultural landscape filled with a synthesis of various genres of contemporary art – installation, architecture, sculpture, artifacts, etc.;

5) a museum of one historical event, accident, crime, cataclysm (Museum of the Siege in Leningrad, Holocaust Museum, Berlin Wall Museum, Jewish Museum or Monument 9/11);

6) a narrow thematic commercial museum as a reflection of mass culture (museum of dolls, wax figures, automobile museum).

Culture and art museums characterize society in a more interesting way. They emerged in the 16th–17th centuries, when the most developed European society at that time realizes the importance of its traversed cultural path and begins to accumulate important cultural values.

Fig. 2. The Tate Gallery in London

Fig. 3. Frank Lloyd Wright demonstrates the Model of Museum to Solomon Guggenheim and his wife

The classical museum is a museum of the first type. It is a building in which separate cultural works are collected, sometimes unrelated to each other by some concept. They have some common features, such as the country of origin, the period of time, or the event. The most vivid examples are the State Hermitage Museum, the Tretyakov Gallery, the Tate Gallery in London [11], and the classical Louvre. These are huge, usually classical buildings, united by passages, formed as some strata for centuries, representing the axis of the culture of the whole country. They are eternal and in-corruptible, on the one hand, and unapproachable, on the other.

However, in the 21st century, in order to remain interesting and please the modern spoiled visitor, one has to demonstrate unexpected exhibits (Fig. 2).

Museum as a masterpiece of modern architecture is a second type of museum emerged in the middle of the 20th century. It is a form of private ownership of art or cultural objects. One of
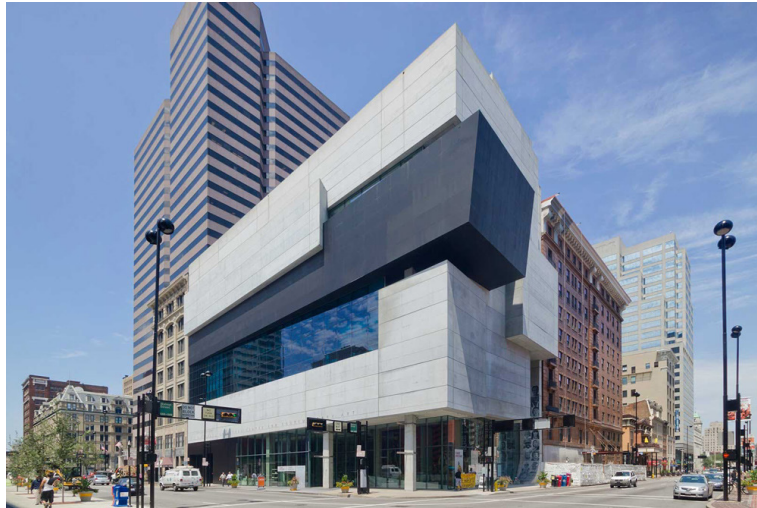
Fig. 4. Rosenthal Center for Contemporary Art (2003)

Fig. 5. Guggenheim Museum Bilbao (1996)

the first such museums is the Solomon Guggenheim Museum in New York. As early as 1937, he began to collect art objects in order to turn to the famous architect Frank Lloyd Wright (Fig. 3), who created a project for him on 5th Avenue near Central Park [12]. The purist spiral cylinder allows museum keepers to slide downward and experience the lightness of being. The only tragedy of the project was that neither the Guggenheim nor Wright saw the opening of their brainchild in 1959.

The Solomon Guggenheim Museum characterizes the emergence of a new type of museum as a work of modern architecture. The difference is that if classical museums, as a rule, were located in the already existing palaces of nobles or kings, then the new museum was originally designed as a museum.

The main typological feature of its architecture is the presence of a huge public space or atrium for opening ceremonies, lectures or large exhibits, which distinguishes the classical museum, which was previously involuntarily content with enfilades of ceremonial rooms as the main exhibition spaces.

Another feature of the second type of museum is the volumetric perception of architecture, and not porticoes and facades inscribed on the red line of historical buildings. There are exceptions though – the Cincinnati Museum of Contemporary Art (architect Zaha Hadid) has normal facades along the red line (Fig. 4) [1].

Fig. 6. Museum of Modern Art, Milwaukee (2001)

In 1996, another Guggenheim Museum was designed in Bilbao by architect Frank Gary (Fig. 5). This is an important landmark project that has shown a number of processes in the architectural world. Firstly, this is the first large completed project in the style of deconstructivism – a style that was bright, but until then underground and not taken seriously in the architectural arena. Before that, all of Zaha Hadid's bold competition projects in this style remained on paper.

The project of the museum in Bilbao broke the ice of the investor's attitude to deconstructivism as to eccentric paper architecture around the world and today, 25 years later, deconstructivism is still one of the main current architectural trends. Secondly, this project showcased new aerospace technologies in architecture. Not long before that, Frank Gary buys out NASA's outdated 3D program, which for the first time made it possible to model a complex 3D surface and send it in the form of a model as a signal to a CNC machine.

It is also the world's first building with a titanium facade. In general, historical con-text, this building personifies the "techno-baroque" of the late twentieth century. Crazy, cramped, almost useless in its tricks, it produces only a visual effect.

Thirdly, this museum has become a household name and created the so-called "Bilbao effect". Before the construction of the museum, Bilbao was a provincial Spanish "town". Today it is an international center for culture, tourism and contemporary art. The museum has become a powerful attractor, a magnet for raising the status of the town to the level of a world cultural center.

A similar phenomenon was the construction of the Museum of Contemporary Art in Milwaukee (USA) by Santiago Calatrava in 2001 (Fig. 6). The building embodies all the ideals of its organic engineering architecture. The structure of the covering of the central exhibition hall is mobile and unique. The transparent outer covering in the form of a spatial system of lamellas rises depending on the illumination and at sunset gives the structure the image of a soaring bird. Here all the elements came together in one place and at one time – the ideal view of the ocean, the landscape, the customer's taste, the need for culture and art, and the talent of an engineer-sculptor. According to the author, this building is the best masterpiece of the master for all the years of his work [8].

Museums of this kind, which made a splash in newspapers even before the competition, are now built everywhere, but their time in the public sense is gone. These museums are temples of money, which have become the joy of the pride of the minority to promote their own, little

Fig. 7. Center for Contemporary Art Georges Pompidou (1977)
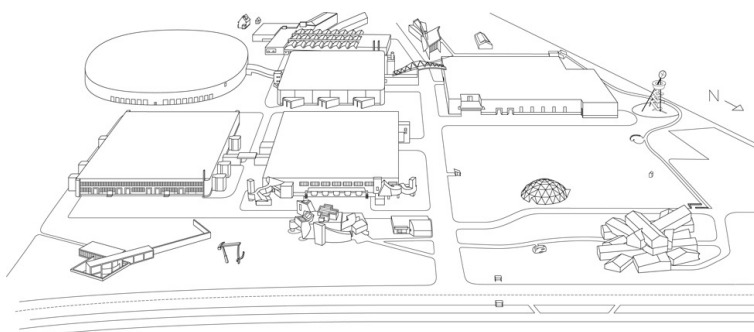
Fig. 8. Vitra – Museum, Weil am Rhein (1990–2000)

understood by society, social, cultural and geopolitical interests. Museum of this kind differs little from the Louvre (Fig. 7). You also "creep in" there in complete depression from the fact that your "daub" of an unknown and unnecessary artist will never touch these sacred walls. For the first time this stereotype was tried to break the most liberal and therefore short-lived French President Georges Pompidou [14]. He was aware of the breakdown and tension of the 1960s. He was aware of the se-cession of the elites and anticipated the events of 1968. And therefore he understood that if he did not want a revolution or war, then it was necessary to bring contemporary art in France out of The concept of the Pompidou Center is a contrast to the Louvre – the temple of eternal imperishable classical art, next to which human life is an instant, and the role of the person looking at it in the global cauldron of beauty is insignificant. Pompidou is Antilouvre. Pompidou is ready to recognize the artist as a genius during his lifetime, to meet him and accept works that have not yet been tested for a century, as well as to give the artist shelter and a home in his studios. Pompidou is more democratic, but angrier. He, like the Louvre, pulls you into its nets and does not let you go for 6 hours, but the emotions at the exit are different. The contemporary museum of the early 21st century has lowered the bar.

Conceptual art, starting with the early conceptualism of the 1960s, originated only at the interface with the viewer. "No spectator – no art!" If you recognize it as something interesting, it automatically acquires the status of the work of art.

Fig. 9. Museum of Victory (1975)

Fig. 10. Monument 9/11. New York (2011)

A similar macro process takes place today with the phenomenon of a private museum. From the perspective of the Louvre and the Hermitage, the concept of a museum has become smaller, but it has become more accessible to the general public. Museum, what-ever it may be, elevates a person. He pulls him out of the shackles of shopping centers – new commercial museums of consumption of the 21st century and urges not to consume, to think and grow morally, no matter what industry. Today the third generation of museums has appeared. This is an open-air installation museum. The prototype of such a museum was the Vitra Museum in the town of Weil am Rhein in Germany (Fig. 8).

This is an open-air museum of modern architecture. Here Vitra has created a collection of contemporary architecture by the likes of Jean Prouvet, Frank Gehry, Nicholas Grim-shaw and Zaha Hadid. For the first time, the museum has lost its traditional "shell" and become free.

The museum is no longer bound by the stereotypical framework of a mono-function. It is no longer just a museum, it is music, recreation, literature and reading, installations and television

Fig. 11. Air Force Museum in Monino (Moscow, Since 1956)

Fig. 12. Museum in Chernousovo – open-air museum of cars

programs. A new multimedia type of museum is emerging, where various information tools contribute to the most voluminous integral perception of an object or phenomenon in culture, technology or art. An important Museum – a memorial of the second half of the twentieth century in St. Petersburg can be considered a monument to the heroic defenders of Leningrad, built by architects S.B. Speransky and V.A. Kamensky in 1972–1975 (Fig. 9).

The monument included a torn ring composition dedicated to the breakthrough of the blockade of Leningrad, framed by sculptures on the theme of the war. Inside, in the basement of the monument, there is a memorial hall, illuminated with 900 lamps made from shell casings and filled with 12 sarcophagi illustrating the pages of the siege history. The composition in the center of the square is completed by a vertical stele with a height of 48 meters, dressed in granite. The monument was inaugurated on May 9, 1975. Today, 40 years later, the architecture and concept of the monument still look relevant.

The tradition of memorial museums at the site of tragedies continues with the newest 9/11 Museum, opened on September 11, 2011 to commemorate the collapse of the WTC Twin Towers in New York (Fig. 10). The memorial is a complex of the upper memorial and the enfilade of the museum, submerged below ground level, which expresses the image of death and the

immersion of 2977 victims into non-existence forever [10]. The interior suites of the museum tell about the history of the building and show artifacts of the tragedy, such as fragments of the building after the collapse and photographs of what is happening.

Further development of a democratic museum can be called open-air museums. These are the Air Force Museum in Monino (Fig. 11) and the Museum of Classic Soviet Cars in the village of Chernousovo (Fig. 12).

The Monino Museum was established in 1956 and consists of decommissioned operating aircraft from the USSR and Russia. Aircraft are in the open air.

The largest private open-air car museum on the plain of Central Russia was created by Mikhail Krasinets, a former race car driver and auto mechanic of the AZLK racing team. The museum is shocking with its undisguised magnificence, open to all winds [9]. Not only is it not a building in the usual sense of the word, but it also does not have a more or less comfortable area and paving. The museum is spread over the classical Russian plain.

Here democracy and a certain enthalpy reach a maximum. For decades, works of technology stand in the open air and smoothly disappear from corrosion and wind erosion. This is the highest plan invisible to an average person. This is the drama of the historical legacy of USSR technology [16]. It is not bad, no, it is just the truth. That is why these museums are the most truthful museums on earth. Why do people go to the museum? They want to "see and hear" the truth. In modern private open-air museums, we hear the truth of history like never before.

Conclusion

The museum as a type of building and structure has come a long way over the past 200 years. From classical palaces filled with unapproachable and eternal works of art of the 19th – early 20th centuries, through expensive masterpieces of super-expensive and equally inaccessible modern architecture of the second half of the 20th century, the museum as a type of activity remained available only to corporations and states. At the end of the 20th and beginning of the 21st century, everything changes. The museum is be-coming a multi-layered concept. The classic state museum is preserved, but many new types of democratic private museums are emerging. The museum is becoming a fashionable youth phenomenon, a way to spend time with not only ingenious "500-year-old masterpieces", but also the lifestyle of the last decades. The museum has become a way of transferring information about the style and way of life, fashion. However, despite the external decline in the status and the very concept of a museum of the 21st century, an important cultural and educational institution resists the processes of personality de-cay in the era of the information society of consumption.

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Эволюция музейного пространства XX в.

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Ключевые слова и фразы: музей; история; галерея; пространство; архитектура.

Аннотация. Цель исследования заключается в сборе и структуризации информации о ярких представителях музейной архитектуры XX в., в анализе тенденций изменений архитектуры, а также функций и особенностей музейных построек разных периодов. Задачи исследования: на примере нескольких ярких представителей архитектуры музеев XX в. проследить, как менялось отношение человека к музею, и показать, как изменения в обществе повлияли на эволюцию музея, а также каким образом глубина отношения к истории влияет на фундаментальность формы музея. Гипотеза исследования: музей эволюционирует вместе с обществом. Музей из элитарного и аристократичного объекта истории превращается к концу XX в. в индустрию развлечений, обретает множество форм: от традиционно дорогих и сложных до новых, демократичных, популярных. Результаты: рассмотрены наиболее яркие представители основных типов музеев XX в., изложены их особенности, обозначены закономерности их развития, процесса демократизации музея как института.

UDK 334

Islamic Banking in Russia and Nigeria for Development

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Key words and phrases: Russia; Nigeria; Islamic; banks; development; Shariah.

Abstract. This research goal is to look into how Islamic banks and financial institutions can contribute their quotas to the development of any society they might find themselves. Both theoretical and methodological approaches were used to crave out the needed information to buttress the facts and figures acquired by Islamic banks in Russia and Nigeriaб respectively. It is found that Islamic banks have gone beyond Russia and Nigeria and has reached even the United Kingdom despite the restrictions and financial hurdles presented before it. Russia and Nigeria are non-Islamic based hubs. The hypothesis used in this work is regression analysis; Shariah Islamic banks in Russia and Nigeria's data were used for forecasting purposes.

Introduction

Islamic banking is best described as a "non-interest" bank. This draws so much attention to why it exits as a financial institution if it doesn't derive "interest" from its clients. Islamic banking however has a root which was designed by Ahmad Elnaggar an Egyptian economist, the idea was to share profit in the city of Mit Ghamr in 1963. However, in 1971, Nasir Social bank became an "interest-free" bank but notably with no affiliation to Islam or Shariah (Arriff 1988).

According to Shaikh Mahmud Ahmad 1989, "every crisis led to renewed efforts by reformers and religious activists to revive the pristine glory of Islam. Islamic banking was born due to the agitation of the people. There is need for people to survive, strive and get access to money without interests. Customarily, financial institutions get funds from the collection of deposits on which banks pay interest and the issuing of loans for which banks receive interest income. Islamic banks are the contrary, they eliminate "interest" and provide services according to Shariah or Islamic norms.

According, F. Al-Omar and A. Mohammed (1996), the four principles of Islamic banking are:

1) paying or charging an interest is considered an exploitative practise;

2) investing in businesses involved in prohibited activities, such as selling alcohol or pork are prohibited;

3) speculation involving gambling is highly forbidden by islam;

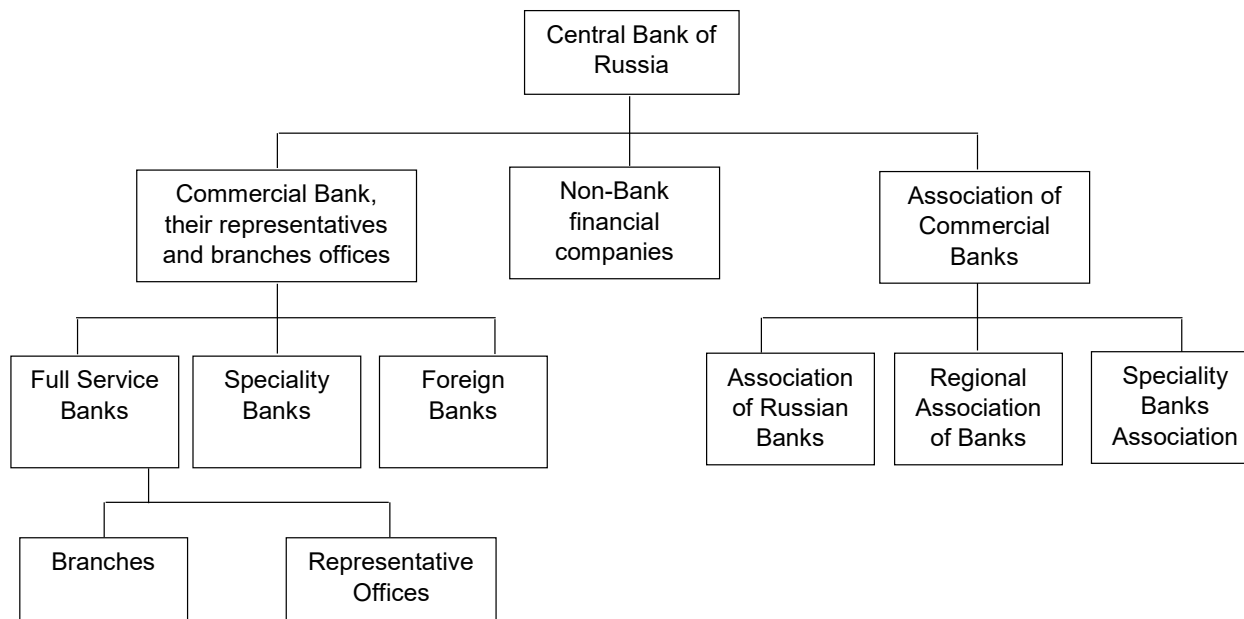4) uncertainty and risk means contracts with high risks are also prohibited; the level of

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                    ┌─────────────────┐
                    │ Central Bank of │
                    │     Russia      │
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Fig. 1. The Structure of the Banking System in Russian Federation

awareness about Islamic banking has to rise in Russia and Nigeria and people need to embrace this phenomenon.

Islamic Banking in Russia

Russia as a country with a bi-level banking structure, it is represented at the top by Central Bank of the Russian Federation. The next level is occupied by banks and non-bank financial institutions which include agencies offices of foreign banks. The Central Bank of the Russian Federation has the ultimatum power and functions differently from every other bank. It's mainly responsible for regulations and money control of all banks in Russia while the other banks on the next level are mainly lending representatives. There are 346 banks (237 Banks with universal licence and 109 banks with basic licence) and 37non-bank financial institutions.

For a long time, Islamic bank were not able to penetrate into the Russian market because of Soviet Union and religious reasons. The only bank which operates in Russia with Islamic views back then was Badr Forte Bank of Kazakhstan; it was operational from 1996–2006. However, in 2016, the first Islamic bank was opened in Kazan Russia, the Partnership Banking Center. According to the Tatarstan Finance Minister Artem Zdunov, the lack of foreign borrowing has made Russia look for other sources of financing, including Muslim countries.

Challenges of Russian Islamic Banks

While lots of authors focussed on the challenges faced by Islamic banks in Russia, I want to emphasize its prosperous future and becoming a leading force in the banking sector of the Russian Federation. As a new comer doing business in an unfamiliar territory (given that Russia in general is not an Islamic country with Islamic norms in circulation), there will always be issues to ride on before the storm calms. According to Islamic Corporation for the Development (**ICD**) 2020, the total value of Islamic banks in 2019 is 2.88 trillion US dollars which means it is still
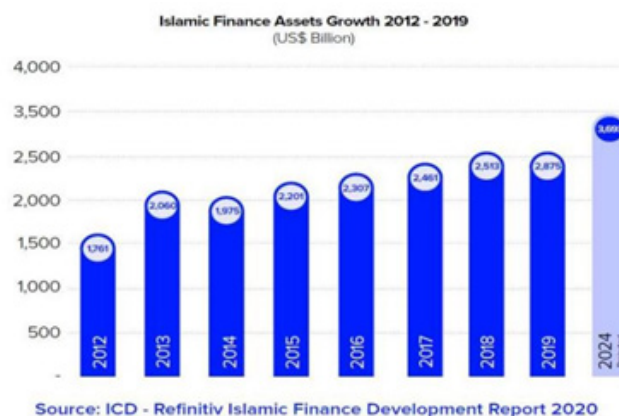
Fig. 2 The total value of Islamic Banks as of 2019

evolving and will find its place in the market with time.

Another clear reason why Islamic banks will continue to struggle in Russia is the lack of a Shariah panel. These specialists are entrusted with managing and maintaining the Islamic banks based on the teachings of the Holy Quran, making sure all activities comply with aims of Islam. According to Z. Vladisslav 2018, it must be noted that despite the fiscal nature of the tax policy, the level of tax rates in Russia is significantly lower than in many other countries. In particular, at present, the general profit tax rate (corporate tax) in Russia comprised 20 %, value added tax is 18 %, individual income tax is 13 %, and a system of tax benefits and deductions with respect to VAT is on effect.

Islamic Banks in Nigeria

After series of phases of development after the colonial era, Nigeria boasts of bigger and stronger banks in today's time. According to H. Charles (1998), "yet the banking sector was expected to support the major shift in the economy to private sector activity while undergoing considerable changes".

In Nigeria, the Central Bank of Nigeria (**CBN**) is the apex of the Nigerian banking system. It presides over affairs of all other banks in the country. The aspects it focuses on are mostly; Capital base statutory reserves, bank size distribution, bank distribution, bank obligations debtor/creditor relationship, relationship from contract and relationship between bank and shareholders. It also manages cost, volume availability as well as the direction of money and credit into ensuring its economy strives.

Nowadays, there are 21 commercial banks operating in Nigeria, 860 micro-finance banks and five development banks. All Nigeria banks run on a N25 billion (about $61 million) capital base.

In 2012, the CBN granted Jaiz bank an Islamic bank to operate an interest-free banking in the Northern part of Nigeria. This was a game changer because before then, people had to pay interests on any fund received from the bank. Unlike Russia, Islamic banking started earlier and has already existing "shariah" laws to guide it. Instead of the traditional interest, the entrepreneur divides his profits with the bank, and the latter in turn with the depositor.

Jaiz bank's total assets were valued at US$88.8 million (NGN:14.1 billion), with shareholders' equity of about US$63.6 million (NGN:10.1 billion). The Bank operates 27 branches and provides
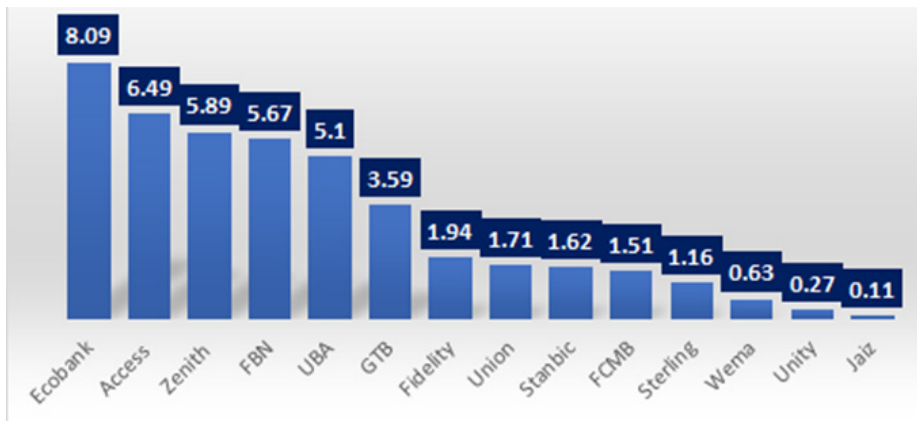
Fig. 3. Total asset of public banks in Nigeria (tn)
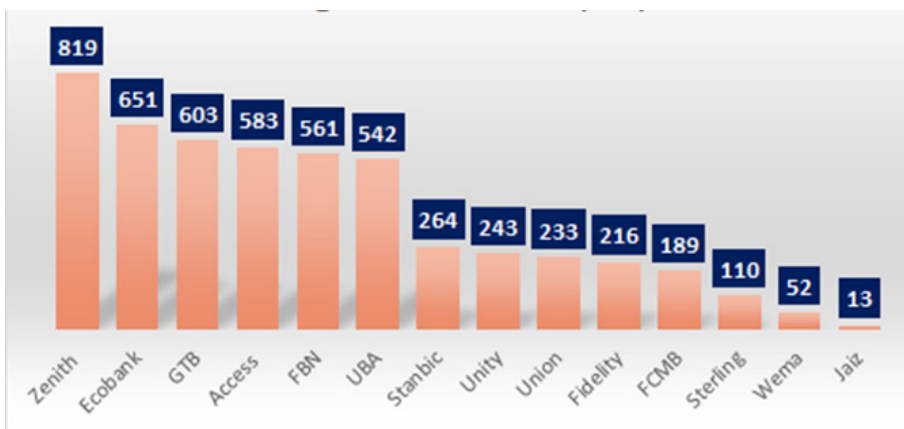
Fig. 4. Shareholders' equity of public banks in Nigeria in 2019 (bn)

regular ATM service as well as online, mobile, and SMS banking services. On the other hand, the Partnership Banking Center of Russia is still trying to sort out its documentation and funds. Although AK Bars bank another Russian Islamic bank which started to operate under "shariah law" in 2014 is a top 20 bank in Russia. A notable similarity of Jaiz with Ak Bars is that they have crossed border lines of operating only in Muslim regions.

Challenges of Nigerian Islamic Banks

The major challenges confronting the application of 'Ijãrah (leasing) products in Jaiz Bank Plc can be categorized into institutional and operational challenges (Adeyemo Wale Lateef; Dr. Syahirah Abdul Shukor; Dr. Amalina Ahmad Tajudin 2017). From lack of Interest-free Loans from Central Bank of Nigeria on 'Ijãrah (Leasing) products of Jaiz Bank to very low awareness by the public coupled with the Covid-19, Jaiz bank has mountain of issues to deal with. According to A.U. Muhammad and M.G. Gulani 2013, "the study found out that 98.1 % of the respondents are aware of Islamic Banking but only 35.2 % are aware of their products and services".

While Jaiz might not be faced with problems like total absence of "shariah laws" like in Russia with Ak Barks bank, laws by Central banks and other accountable organisations of these respective countries stand as a stumbling block. For example in Nigeria, the Non-

Interest Financial Institutions (**NIFIs**) framework was drafted on the platform of conventional banking system, thus, matters relate to liquidity and risk management requirements are not comprehensive enough to absorb Sharī'ah principles guiding liquidity and risk management under Islamic banking system.

Islamic Banks Contributions

Just as Ak Bars of Russia trying to influence and make meaningful contributions to lives of ordinary people so is Jaiz. This year 2021, it swung into action of easing the process of the holy pilgrimage for Muslims travelling to Saudi Arabia for "Hajj" (The greater Muslim pilgrimage to Mecca). Of course, it was positively met by the public and further show that Islamic banks in Nigeria and Russia are dedicated in touching every aspect of people's lives.

The potential of an effective Islamic bank in Russia is very high as we see AK Bars Bank of Russia already giving out mortgage to clients based on Islamic values. C. Dimitry 2019 says: "The launch of Non-compliant mortgage program as Ak Bars Bank (republic of Tatarstan) also testifies to Russia's interest in the development of Islamic banking".

Jaiz bank is a public company owned by over 26,000 shareholders spread over the six geopolitical zones of Nigeria, this shows that it's head-bent on making sure development and riches are shared evenly everywhere around Nigeria.

Conclusion

This study is to look into how Islamic banks affects the community they find themselves positively, people's loyalty and patronage. From all above, it's clear that people are interested in banking and working for Islamic banks. People are investing and are happy to get help of different kinds from these banks. These positivity has encourage Islamic banks in Russia and Nigeria to continue to expand to reach and touch everyone with shariah's banking ethics.

Both CBN of Nigeria and the Russian Central banks of Russia has to create laws to make Islamic banks functioning properly in the legal framework to operate fully.

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Потенциал развития исламского банкинга в России и Нигерии

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Ключевые слова и фразы: Россия; Нигерия; ислам; банки; развитие; шариат.
Аннотация. Целью исследования является изучение потенциала исламских банков и финансовых учреждений для развития общества. Исследование проводилось на основе статистических данных исламских банков в России и Нигерии с привлечением как теоретических, так и методологических подходов. Установлено, что исламские банки осуществляют финансовую деятельность за пределами России и Нигерии, в том числе на территории Соединенного Королевства, несмотря на существующие ограничения и финансовые препятствия. Россия и Нигерия являются неисламскими финансовыми центрами. Гипотеза исследования построена на модели регрессионного анализа; в целях прогнозирования использовались данные шариатских исламских банков в России и Нигерии.

UDK 338

Refinement of the SOA Reference Model in Accordance with the Agreement-Driven Service Architecture

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Key words and phrases: agreement-driven service architecture; reference architectural models Service-oriented architecture.

Abstract. The purpose of the study is to analyze the possibilities of using an Agreement-driven Service architecture (**ADSA**) to expand the model of Service-oriented architecture (**SOA**). It is assumed that the use of ADSA will complement the SOA model with a service quality management system and eliminate the lack of formalization of this architectural model. The objectives of the study are to identify the shortcomings of SOA that need to be eliminated for use in enterprises for which the quality of activity is the most important characteristic; the formation of an architectural model to complement SOA ADSA and describe the main features of such a combined architectural model. The study uses methods of architectural modeling and integration of two architectural service models. As a result of the study, a combined model is formed and described that integrates SOA and ADSA and allows using the advantages of both models.

Introduction

Service-oriented architecture (**SOA**) describes the mechanism of organization and use of elements in a distributed system. This architecture is based on a satisfaction the needs of one software component, which is called a service consumer, with help another, a service provider. The main concept of the SOA reference model [1] is a service. In SOA, it is defined as follows: "A mechanism for providing access to one or more features provided by a service provider, where access is provided using a prescribed interface and is carried out in accordance with the restrictions and policies specified in the service description".

SOA reference model

The main elements of the SOA model are listed below.
- Description of the service: Information required in order to use or consider using the
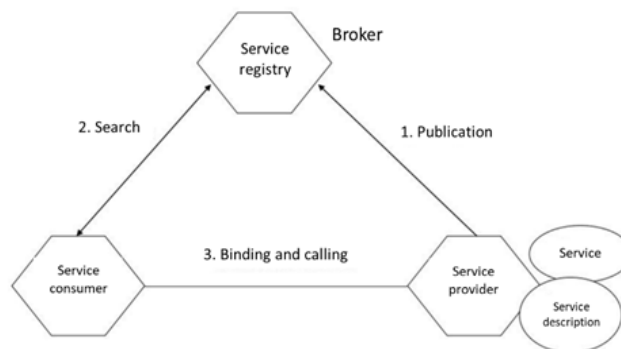
Fig. 1. Reference architectural model SOA [1]

service. The purpose of the description is to facilitate interaction and its visibility between the participants of interaction with the service, especially when the participants are with different owners.

•   Visibility: the ability of those who have needs and those who have opportunities to find and interact with each other. Visibility includes not only that the service exists, but also that the consumer is sufficiently aware of the supplier, and the supplier knows the consumer that there is a willingness between the parties to start or continue interaction. This is usually done by providing descriptions of aspects such as features and technical requirements for the service, related restrictions and policies, as well as access or response mechanisms.

•   Interaction: Refers to the interaction between service providers and consumers. Typically defined by messaging, the interaction proceeds through a series of exchanges of information and called actions. The result of the interaction is a real effect.

•   Real effect: the actual result of using the service. This can be a return of information or a change in the state of objects (known or unknown) that participate in the interaction.

•   Execution context: a set of technical and business elements that form an environment between those who have needs and those who have the ability to meet them, and which establish the conditions under which service providers and consumers will interact. All interactions are based on a specific execution context that allows service providers and consumers to interact and provides a decision point for any policies and contracts used.

•   Contracts and policies: a policy is some restriction or condition regarding the use, deployment, or description of an owned object as defined by any participant, while a contract is an agreement between two or more parties. The reference model focuses primarily on the concept of policies and contracts as they apply to services.

The architectural model of SOA is shown in Fig. 1.

The main elements of this model are a service provider, a service consumer and a broker.

The service provider provides a service for web services, the most popular variant of SOA, when services are provided over the Internet, defined by a description in a special language WSDL – Web Service Definition Language.

The service consumer is interested in discovering and then using the desired service.

The broker is a registry of services that stores information about services and providers representing them and provides consumers of services who have applied to it.

However, along with the undoubted advantages of SOA, such as:

•   formalization of interfaces between software components based on the concept of service, avoiding heavy monolithic applications that are expensive both during implementation

and during operation;
- • encapsulation of service implementation and polymorphism of their implementation;
- • reuse of software components that provide services;
- • providing an opportunity to build flexible applications;
- • simplify support and modification of software applications.

This model has a several disadvantages, primarily related to the lack of detail of the model. Therefore, service providers differ greatly not only in the ways of implementing services, but also in the ways of calling and working with services and their quality. And this in turn negates almost all the advantages of the model.

The concept of service

However, the concept of a service is not limited to its role in the SOA architecture. In addition to the fact that the service has firmly taken its place in the field of business, and the trend of transition from the provision of goods to the provision of services has become one of the main directions of development of many companies around the world, a service or service as that part of the service that is addressed to its consumer is the basis of the technology of operation and support of information technologies (**IT**).

The IT field, as a very young and rapidly developing field of activity and business, uses the experience of related fields, and has managed to acquire a large number of standards, best practices and frameworks. As soon as personal computers appeared and it became clear that it was impossible to use them without a competent organization of their operation and user support, Information Technology Service Management (**ITSM**) technology emerged [2], which, as can be seen from its name, is based on the concept of service. Pretty quickly, this approach became established and began to be used by most organizations around the world. Its further development is associated with the ITIL Information Technology Infrastructure Library [3–5] and the ISO/IEC 20000 series of standards based on it [6]. One of the most important elements of the last two sources is the concept of SLA, Service Level Agreement, i.e. quality of services.

Indeed, the SOA model does not explicitly mention the quality of services. Although it presents the element "Contracts and policies", it is not an element of the architectural model shown in Fig. 1 and is not specified in the description of the reference architectural model of SOA [1].

However, when using services in other areas, in particular in IT, SLA is an essential element, moreover, for architectural models of different types: organizational, functional, technical, commercial. In particular, SLA is the basis of the commercial relationship between the supplier and the consumer of the service.

It is SLA that makes it possible to ensure the quality of the enterprise architecture (and in general, we can also talk about the architecture of other systems), and therefore the quality of the functioning of the enterprise itself.

It seems promising to introduce SLA into the system of elements of the SOA model, thereby increasing its reliability and manageability.

ADSA model description

Agreement-driven service architecture (**ADSA**) was described by the author in a number of papers [9–16] and presented at several international conferences, in particular, at the conference
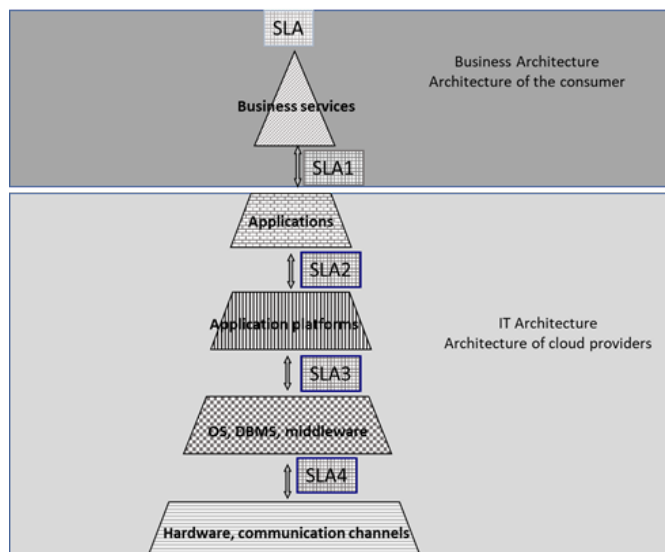
Fig. 2. Conceptual model of ADSA

Enterprise Engineering and Knowledge Management 2017–2021. It is an architectural style that is part of the family of styles of service architecture. A feature of the ADSA is the addition of the concept of service to the concept of the service level agreement (**SLA**), which determines the agreement between the supplier and the consumer of the service on the quality with which the service is provided. Accordingly, the SLA determines the mutually agreed needs of the contractor and the capabilities of the supplier regarding the quality of the services provided.

The implementation of the agreement is monitored when providing the service, and its violation entails a system of measures, both technical and organizational, and even commercial. In particular, if the service provider provides commercial services for the provision of the service, then the violation of the agreement entails financial sanctions. Monitoring the implementation of the agreement can occur both automatically with the help of various tools and methods up to smart contracts, and semi-automatically.

The conceptual model of ADSA is shown in Fig. 2.

It should be noted that the characteristics of the SLA shown in Fig. 2 are subject to the following inequality: SLA > SLA1 > SLA2 > SLA3 > SLA4 due to the inevitable attenuation of SLA parameter values at each architectural level.

It is obvious that the model shown in Fig. 2 is useful for cloud services when different architectural levels are provided by different legal entities. In this case, SLAs can also serve as an appendix to the contract between the supplier and the consumer of the cloud service.

Fig. 2 shows SLAs linking different architectural levels, but SAUS can also be applied to elements of the same architectural level, in particular, the software application level.

Refinement of the SOA model using the model ADSA

Among the elements of the SOA model, a separate place is occupied by policies and contracts, the first of which define restrictions or conditions regarding the use, deployment or description of the service, and the second – agreements between other elements of the SOA architectural model, most often between the provider and the consumer of the service.
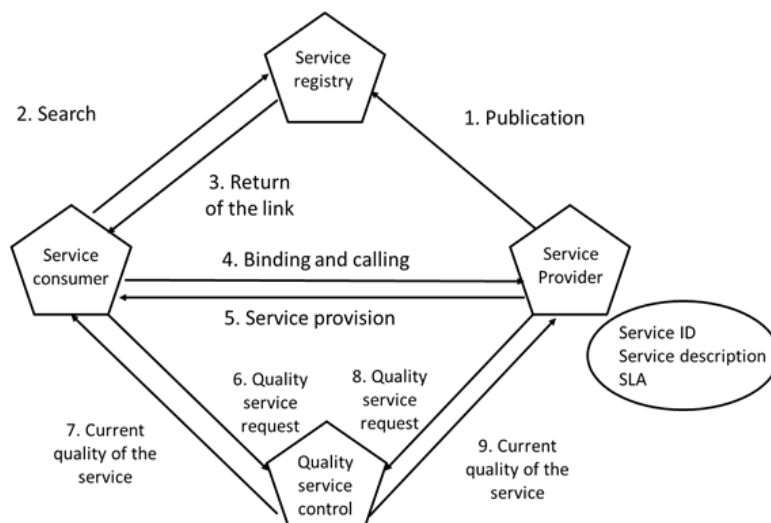
Fig. 3. Architectural model of SOA – the extended ADSA

However, in the SOA reference model, neither the agreement nor the contract are formalized. It is proposed to extend the reference architectural model of SOA with the element "service quality control" and add an SLA that includes characteristics important for the service and its participants. Thus, the model presented in Fig. 1 can be expanded as shown in Fig. 3 and described below.

1. The publication of the service includes a unique identifier of the service, a link to it, a description of the service in WSDL, a description of the quality of the service in SLADL, which are provided by the supplier. A brief description of the SLADL structure is given below.

2. The service search includes the search for a suitable service by the description of the service on the WSDL and the description of the quality of service required for the consumer on the SLADL.

3. The element of the architectural model that maintains the register of services transmits to the service consumer a link to the most suitable provider of the requested service with the best SLA that suits the consumer.

4. Using this link, the service consumer calls the service provider and sends him a service request.

5. The service provider responds to the service consumer and provides him with the requested service.

6. The consumer of the service refers to the element that controls the service according to the characteristics specified in the SLA of the service, with a request for the current quality of the service. Such requests can occur both periodically, at intervals set by the consumer, and on request.

7. The "service quality control" element returns to the service consumer the current value of the service characteristics specified in the SLA. As such elements can act as information systems of the class.

To form the characteristics, it is proposed to use a number of standards and best practices given in [7–8].

In particular, such characteristics include:

• reliability of the service, characterized by the number of failures per unit of time and operating time for failure;

- performance characterized by service throughput, service response time/latency;
- availability, characterized by the frequency and duration of service downtime;
- support, characterized by the service recovery time and the time of providing support.

The requirements for the values of these characteristics should be described in the language Service Level Agreement Definition Language (**SLADL**).

SLADL (Service Level Agreement Definition Language) definition

SLADL is a language for describing the characteristics of the quality of services for the SOA model, which has the following features:

- SLADL is an XML-based protocol for exchanging information about the quality of services in decentralized and distributed environments;
- SLADL definitions describe the characteristics of the quality of services that are subject to control during the provision and use of services;
- SLADL is a candidate for inclusion in the register Universal Description Discovery Integration (**UDDI**).

SLADL can be used together with WSDL, usually in combination with SOAP (Simple Object Access Protocol) and XML, when providing Web services over the Internet. A client program that connects to a Web service after reading the WSDL to determine which functions are available on the server reads the SLADL to determine the service parameters that need to be monitored.

All used special data types related to the service itself are embedded in the WSDL file, and – to the quality of the service – in the SLADL file, in both cases in the form of an XML schema. The client can then use SOAP both to actually call one of the functions listed in the WSDL, and to control the performance characteristics of the function described in the SLADL.

Conclusion

Thus, the ADSA model can be used not only to provide communication between different architectural layers of an enterprise provided by different providers, but also to organize the interaction of architectural components of one architectural layer, in particular, a layer of software applications. Further development of one of the most popular architectural models of this layer – the SOA model of the ADSA allows you to build a managed, with the help of quality control services, architecture of this layer. And this, in turn, allows us to ensure the required quality of the architecture of the enterprise and its activities.

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**Уточнение референсной модели SOA
в соответствии с моделью сервисной архитектуры, управляемой соглашениями**

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Ключевые слова и фразы: сервисная архитектура, управляемая соглашениями; сервисно-ориентированная архитектура; эталонные архитектурные модели.

Аннотация. Целью исследования является анализ возможностей использования сервисной архитектуры, управляемой соглашениями (**САУС**) для расширения модели сервисно-ориентированной архитектуры (Service-oriented architecture (**SOA**)). Предпола-гается, что использование САУС позволит дополнить модель SOA системой управления качеством сервисов и устранить недостаток формализации этой архитектурной модели. Задачами исследования являются выявление недостатков SOA, которые требуют устра-нения для использования на предприятиях, для которых качество деятельности являет-ся важнейшей характеристикой; формирование архитектурной модели дополнения SOA САУС и описания основных особенностей такой комбинированной архитектурной модели.

В исследовании используются методы архитектурного моделирования и интеграции двух архитектурных сервисных моделей. В результате исследования формируется и описывается комбинированная модель, объединяющая SOA и САУС и позволяющая использовать преимущества обеих моделей.

UDC 336.7

The Algorithm of Bank's Operational Risk Management in the Context of Digital Transformation

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Key words and phrases: artificial intelligence; banks; operational risk management.

Abstract. The problem of the operational risk management of banks has been relevant for a long time; moreover, in the context of a pandemic in financial institutions, their total number and volume of losses have increased, including damage from new types of operational risks. Since is not possible to use outdated methods to solve current problems, the authors propose the use of a refined algorithm based on artificial neural networks to improve the efficiency of risk management, create a dynamic and adaptive system, and minimize damage. The peculiarity of this algorithm lies in the synthesis of the needs of the bank and the client in safe financial transactions, when external and internal factors are considered that influence the selection for each specific client with his personal characteristics of the product that in the current conditions will bring less risks, and for the bank this option is correlated with his risk appetite. The possibilities of practical application of the proposed version of the operational risk management algorithm are not limited to systematically important and large banks. For many financial institutions, proposals to refine the considered algorithm are acceptable.

Introduction

The relevance of a study of the bank's operational risk management is based on insufficient development of both individual methodological aspects and a holistic algorithm for the management. According to the current researchers, leading positions are taken by risks of the IT sphere and the work of bank employees with databases for a long time by now. Despite the fact that the importance of the digital aspect of risk managementis a well-known fact, the extent of their damage cannot be predicted with accuracy. Therefore the problem of effective management does not lose its relevance (Table 1) [9].

One of the latest large-scale incidents is the SUNBURST malware attack, which caused the data losses from government organizations in different countries. At the same time, the attack began about a year before the incident itself, when the criminals placed the malicious code in

Table 1. Main operational risks

Place	2021	2020	2019	2018	2017
1	IT disrupton	IT disrupton	Data compromise	IT disrupton	IT disrupton
2	Data compromise	Data compromise	IT disrupton	Data compromise	Data compromise
3	Resilience risk	Theft and fraud	IT falure	Regulatoryrisk	Regulatory risk
4	Theft and fraud	Outsoursing and third-party risk	Organisational change	Theft and fraud	Outsoursing
5	Third-party risk	Resilience risk	Theft and fraud	Outsoursing	Mis-selling
6	Conduct risk	Organisational change	Third-party risk	Mis-selling	Unauthorised trading
7	Regulatory risk	Conduct risk	Regulatory risk	Talentrisk	Organizational change
8	Organisational change	Regulatory risk	Data management	Organisational change	Theft and fraud
9	Geopolitical risk	Talent risk	Brexit	Unauthorised trading	Talent risk
10	Employee well-being	Geopolitical risk	Mis-selling	Model risk	

a software update package, and then spread it to users around the world, many of whom held positions in the public service. Thus, not only private firms, but also the state infrastructures were under the threat. And this is just one example of many incidents of various scales.

Moreover, the problem is exacerbated in the context of the COVID-19 pandemic that provoked an increase in the number of users of online products, and the rise of digital infrastructures of financial market organizations.

The acceleration of the implementation of digital platforms with insufficient financial support, in our opinion, entails serious threats and hinders the process of managing the bank's operational risks.

Government wants to take control of the situation and ensure the implementation of preventive and combating measures at different stages of dealing with risks, so the government supposes digital and technological risks to be taken into account with greater accuracy, control and regulation over them to be strengthening, while the legislative process is being active.

It is assumed that financial institutions, in particular banks, should immediately notify the regulatory authorities of incidents that have occurred. In the USA, regulators have set a time limit of 36 hours for the most effective response to a case. Banks face data breaches, system failures and other threats on a daily basis. Therefore, incident response should be improved, be dynamic and flexible, so that it is possible to record a greater number of these incidents, create a unified platform based on the certain algorithm of actions and also take appropriate measures regarding them [7].

However, the improvement of the technical equipment of the financial sector entails both positive effects such as database protection, simplification of work with operations, and an increase in their volume; and negative, reflected in the susceptibility of the systems used to attacks by cybercriminals, fraud and theft of databases. The greater the methods of protection, the more sophisticated tools are used by criminals.

Banks like any participant in the financial market, must assess risks using the most effective and modern models, paying attention to key risks, while not forgetting lesser threats, so the risk management process should be able to rebuild according to external and internal changes.

Methods

Nowadays one of the priority fields of research in risk management is machine learning. Models based on artificial neural networks (**ANNs**) allow you to respond to emerging threats quickly, as well as rebuild learning and self-learning models with less time consuming. Application of ANN models allows minimizing threats and the total amount of losses, building an effective agile approach. It is the ANN-based models that will allow to consider the multifactorial impact of both external and internal events on the final amount of damage and on forecasting in the future.

Operational risks, in turn, have their own specifics that determine how they are assessed, as well as the dynamics of changes. Scenarios can evolve in different ways, but financial institutions should consider the maximum possible number of them, given the likely changes in the regulatory framework, the behavior and preferences of both consumers of banking products and staff, as well as security threats and other factors.

The process of legitimizing digital tools, as well as the establishment of competencies and procedures in certain situations is highly important. Since all over the world, and in Russia too, the issues related to cyber-attacks became a daily occurrence in the financial markets, the processes listed above are accompanied by an endless series of improvements and modernization.

However, not all commercial banks have enough capacity to ensure the most efficient operation and implement the latest developments, including ANN-based models, allowing working with big data, creating forecasting models and preventive mechanisms.

Therefore, the initiative should go downward, from the state, through the apparatus of the Bank of Russia to commercial banks, and eventually reach the consumers of the bank products.

FinCERT, the information security department of the Bank of Russia, which is working to combat cyber fraud by adjusting the legislative framework, as well as practical activities, can serve as a benchmark for the banking sector.

The Central Bank has more resources to carry out such activities, at the same time, it acts both as a provider and as a regulator, and therefore it can capture more areas for reorganization, from rule-making to practical application.

Federal Law № 167-FZ "On Amendments to Certain Legislative Acts of the Russian Federation in the Part of Counteracting the Theft of Funds", published in June 2018, resulted in a number of changes [1].

For example, a legal framework has been legislated to facilitate the exchange of information about persons involved in money theft schemes using payment services. A legal basis has also been created for a mechanism that prevents illegal payments and facilitates the return of funds to real owners in an out-of-court and prompt manner.

The Bank of Russia now has more powers to regulate information security. In addition, "antifraud" was legalized in full, which is monitoring to detect fraudulent activities in the field of electronic payments.

To date, FinCERT has set itself several urgent tasks, including the debugging of information exchange regarding issues of countering computer attacks, moreover, FinCERT provides monitoring, prompt response and analysis of data on incidents related to computer attacks on

financial institutions, and as a result considers it important to provide analytical materials.

It is difficult to imagine the procedure for information exchange within an isolated system, so the key factor is the interaction of various structures, for example, interaction with law enforcement agencies in the investigation of crimes in the field of computer information.

In addition to measures to influence the direct participants in the financial sector, the main task is to carry out activities to improve the level of financial literacy of various groups of people and cooperate with the country's leading universities to train specialists in the field of information security.

To implement all the tasks today, it is impossible to do without automated information processing processes, in connection with this, one of the most significant events in the activities of FinCERT was the introduction of an automated incident processing system, also known as ASOI FinCERT.

From July 1, 2018, in accordance with Bank of Russia Directive № 4793-U "On Amendments to Bank of Russia Regulation №382-P", payment system operators, payment infrastructure service providers, and money transfer operators are required to report detected incidents associated with violation of the requirements for ensuring the protection of information when making money transfers.

As a result of this, the process of informing about incidents switched from the voluntary nature to a mandatory one, the territory of implementation from the scale of the Bank of Russia payment system expanded to all technological areas, and the poorly protected communication channel in the form of e-mail was replaced by the ASOIFinCERT personal account service, which has personalized access and cryptographic protection of the communication channel resulted in a significant increase (more than four times) in the amount of event and incident reports received by FinCERT.

In addition to preventive measures, FinCERT effectively works with current incidents: cases of phishing attacks, elimination of the consequences of computer attacks of various kinds, assistance to banks in identifying points of withdrawal and cashing out funds, assistance in organizing interaction with law enforcement agencies in order to initiate criminal cases, and much more, which indicates the inevitability of risks, including operational ones.

The Basel Committee in 2004 formulated the definition of operational risk: "The risk of losses arising from inadequate or erroneous internal processes, actions of employees and systems, or external events".

In turn, in accordance with the risk and capital management strategy of the Sberbank Group dated April 17, 2018, a concept of operational risk appears.

Operational risk is the risk of losses resulting from deficiencies or errors in internal processes, in the actions of employees or third parties, in the operation of information systems or as a result of external events.

Both concepts have obvious similarities, despite the time step, and even today, they remain relevant, because the indicated causes and effects still continue to exist. However, risk assessment and management methods need to be changed.

There is a certain variation in the methods for assessing the operational risks of financial institutions. In particular, for banks, Basel III identifies as the main ones [8].

1. Basic Indicator Approach, according to which banks undertake to reserve capital for operational risk – in the amount of a fixed percentage of the average annual gross income for the last three years.

The operational risk capital requirement is calculated according to the formula:

$$(GI \times \alpha)/n,$$

where *GI* is the average annual gross income; α is 15 % or a higher percentage set by the Regulatory Authority; *n* is the number of years.

This approach is very primitive, expensive, and does not allow taking into account the whole variety of incidents and management decisions.

The Standardized Approach, according to which the bank's activities are divided into eight business lines, for each of which the amount allocated for possible losses from operational risks is calculated based on the percentage of gross income fixed for each business line. Further, capital contributions for each business line are added up and get a total amount.

2. The standardized approach is based on the factors below:

–   the business indicator (**BI**), which is a financial-statement-based proxy for operational risk;

–   the business indicator component (**BIC**), which is calculated by multiplying the BI by a set of marginal coefficients;

–   the internal loss multiplier (**ILM**), which is a scaling factor that is based on a average historical losses and the BIC.

The restriction of eight business lines is far from suitable for every bank and can hardly be called acceptable in the context of the deployment of cross-digital business lines.

3. Advanced Measurement Approaches are by far the most flexible, allowing you to choose a comfortable and effective toolkit for assessing and managing operational risks. The Basel Committee leaves the banks the opportunity to independently change and improve the methodology based on existing requirements and principles. This method includes the selection of typical areas of activity and the determination of the typical type of losses for each of them, as well as the calculation of the amount of the reserved capital for possible losses in the event of risky events.

It is proposed that the introduction of machine learning to assess and manage operational risks instead of traditional methods of processing statistical information. This will positively affect the effectiveness and work within the framework of the AMA method. Machine learning allows you to identify those patterns (typologies) that were not even considered before. Moreover, peer review as an accompanying process will help to correct the built algorithms for the work of learning neural networks. ANN-based machine learning and peer review will positively influence the formation of a financial organization's operational risk management strategy.

By combining the above two elements within the framework of the AMA approach, using advanced tools and techniques, it seems possible to build a stronger predictive model, improve performance without increasing risks.

Results

According to all that was said, to achieve effective results, it is necessary to have a clear procedure and structure, in other words, an algorithm.

In general, the operational risk management algorithm of banks can be described as an integral structure, the initiative within which belongs to the Bank of Russia, as a regulator, intermediary and guarantor all rolled into one. The previously listed roles of the Bank of Russia make it possible to create a single database that will cover countless incidents of various types associated with operational risks, information about which presumably comes from commercial banks (Fig. 1).

Further, there is an exchange of open information about incidents, but, more importantly, it becomes possible to build a certain order of management decisions when faced with a risk, banks will be able to decide, for example, to accept or transfer risk, relying on a scale of data on
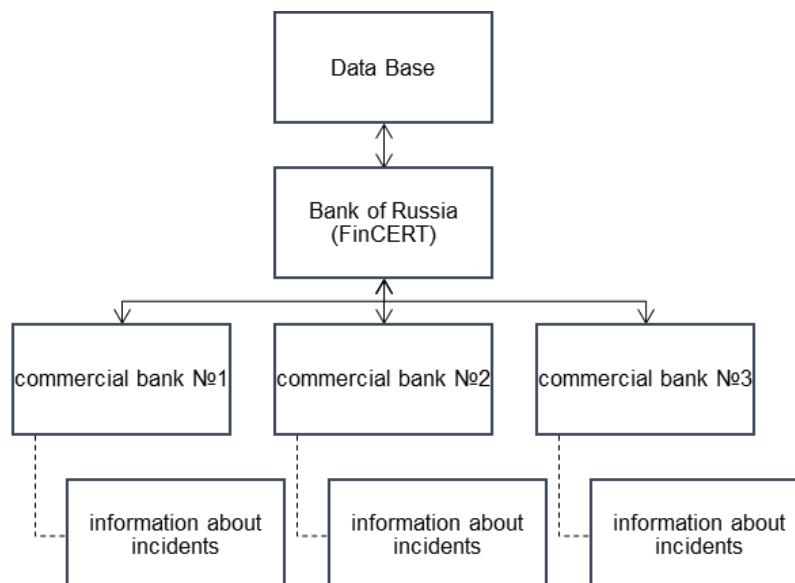
Fig. 1. Bank operational risk management algorithm

such incidents.

An improved algorithm for managing operational risks of banks using the AMA method based on ANN is an information chain of many parameters, where the ASOI FinCERT common database for the banking sector is connected at the input, at the output for each operation we have an analyzed sample from the data array, the maximum execution of the operation and the minimum possible consequences from risks.

The analysis can be complex enough; therefore, for its implementation, we propose to set on one of the categories of banking products, for clarity, the credit products are considered.

The unique feature of this algorithm is in the synthesis of the needs of the bank and the customer in safe financial transactions. So, many factors affect the construction of the model and data analysis, therefore, a special data processing algorithm that allows to take into account external and internal factors that affect the selection for each specific client with his personal characteristics and needs of the product that in the current conditions will best meet his needs and bring less risks, as well as take into account the risk appetite of the bank for related operations (Fig. 2).

It should be noted that the conditions under which the selection is carried out are not limited by the regulatory framework and the security system used. Factors can be varied, up to social characteristics. Depending on the operation and the type of financial organization, the significance of the factors taken into account may differ, moreover, over time, in the course of natural shifts in different areas of human life, some factors may disappear, and others appear. Therefore, it is advisable for the bank to monitor the significance of incidents in order to reconfigure machine learning and make management decisions in order of their significance.

The analysis of all the factors by using the algorithm makes it possible to create more effective system of the risk management that entails the creation of the mechanism which can reduce risks and losses.

For clarity, a matrix of significant risks is presented, in this matrix the most significant risks are highlighted in red (with a high level of vulnerability and a significant amount of damage), medium significance in yellow and less significant risks in green. The results of studies on
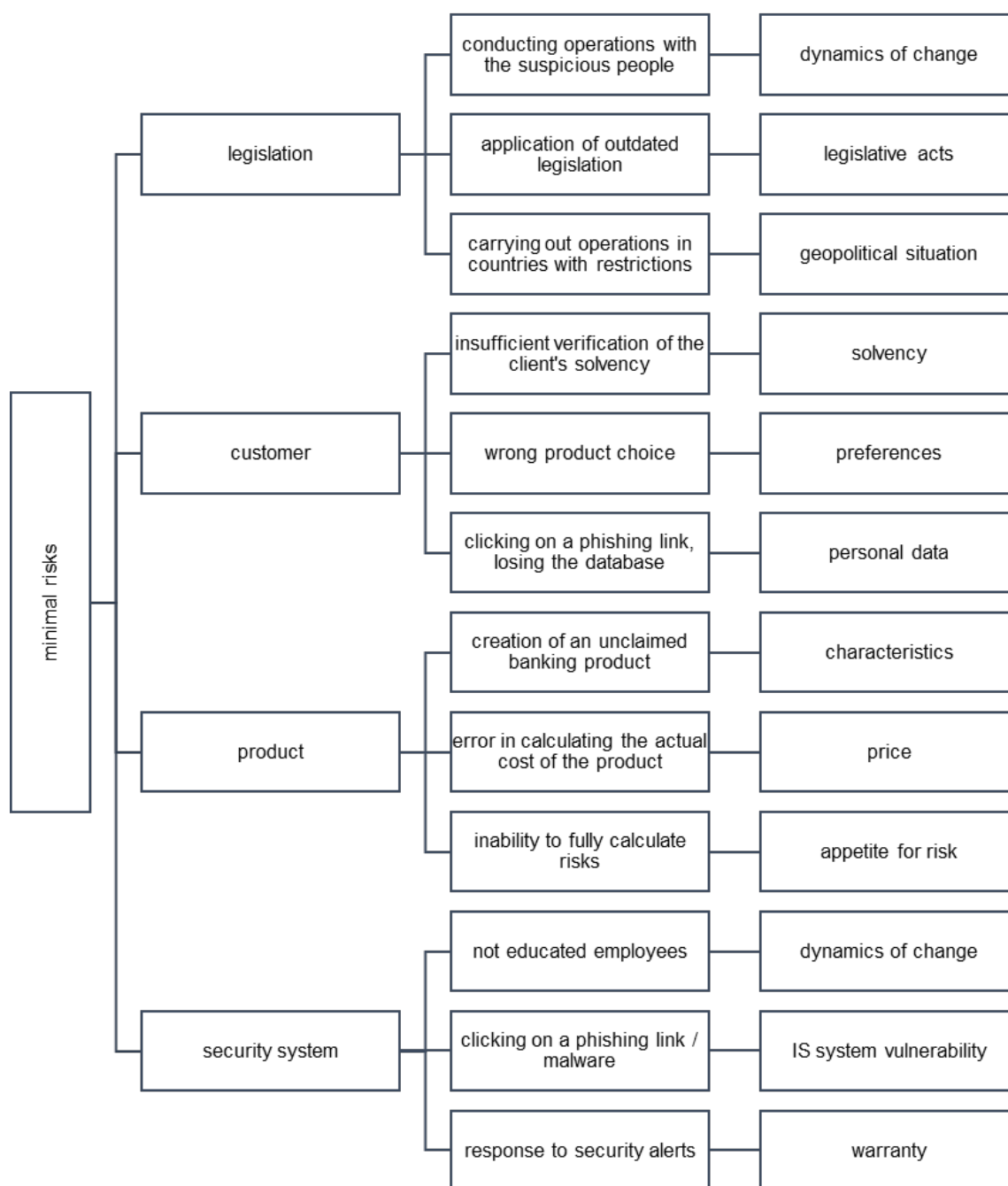
Fig. 2. Simplified scheme for accounting for factors in the framework of the work of the ANN

the levels of significance of operational risks in the context of the transition of banks to digital services and products made it possible to form a gradation of the significance of operational risks of banks for 2021 (Table 2).

The matrix may change under the external and internal challenges and threats, however such a division gives a clear image of the current situation and lets financial organizations to prioritize all the incidents that they may face during the execution of operations.

Table 2. Significance of the incidents

Legislation	Customer	Product	Security system
Conducting operations with the participation of dubious persons	Low-quality verification of the client's solvency	Error in calculating the actual cost of the product	Insufficiently qualified employees
Outdated legislation	Wrong product choice	Inability to fully calculate risks	Clicking on a phishing link – malware
Carrying out operations in countries where there are restrictions	Clicking on a phishing link, losing the database	Creation of an unclaimed banking product	Delayed response to security alerts

Building an improved algorithm for managing operational risks of banks is based on the implementation of machine learning and ANN models, connecting to the ASOI FinCERT database, monitoring of the significance of incidents may positively affect the financial results of individual banks and the banking system as a whole. The opportunities offered by ANN models and government regulation and assistance not only help improve the performance of one financial institution, but generally guarantee better performance through interaction and openness. The creation of a common database helps to quickly respond to incidents by accumulating more and more knowledge about them.

Discussion

Of course, it is just one of all the possible ways of improvement of the operational risks management process and it is not perfect yet. However, it can be implemented in every financial organization as the algorithm is universal. The problem is that not all the financial organization can use the suggested algorithm right away without any help from the government because of the returns to scale issues.

There is a place for a long fundamental research and interdisciplinary approach to forecast weather it is possible to widen the implementation or governmental support is the only way to do it.

And every financial organization, banks particularly, may change the way of the implementation of the algorithm by prioritizing different factors and facing a variety of external and internal difficulties.

What is more, according to the last news there is a problem which relates to the increased appetite for risk. It is difficult to ensure the security of banking products and services of Russia while being under the influence of financial sanctions. The Risk Appetite statement is known for the decentralized approach that means every commercial bank is responsible for the responding on trends and dynamics of changes. However, we suppose it is extremely important to apply the mixed approach to systematize and coordinate financial organizations' actions, it would be much easier to change the risk management system responding to external factors.

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Алгоритм управления операционным риском для банков в условиях цифровой трансформации

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Ключевые слова и фразы: банки; искусственный интеллект; управление операционными рисками.

Аннотация. Проблема управления операционным риском банков актуальна уже давно, более того, в условиях пандемии в финансовых организациях увеличилось их общее количество и объем потерь, в том числе ущерб от новых видов операционных рисков. Использование устаревших методов для решения современных задач невозможно, поэтому авторы предлагают использовать усовершенствованный алгоритм на основе искусственных нейронных сетей для повышения эффективности управления рисками, создания динамичной и адаптивной системы и минимизации ущерба. Особенность данного алгоритма заключается в синтезе потребностей банка и клиента в безопасных финансовых

операциях, когда учитываются внешние и внутренние факторы, влияющие на выбор для каждого конкретного клиента с его личными особенностями продукта, который в текущих условиях принесет меньше рисков, и для банка этот вариант коррелирует с его склонностью к риску. Возможности практического применения предложенного варианта алгоритма управления операционным риском не ограничиваются системообразующими и крупными банками. Для многих финансовых организаций приемлемы предложения по доработке рассмотренного алгоритма.

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FOR NOTES