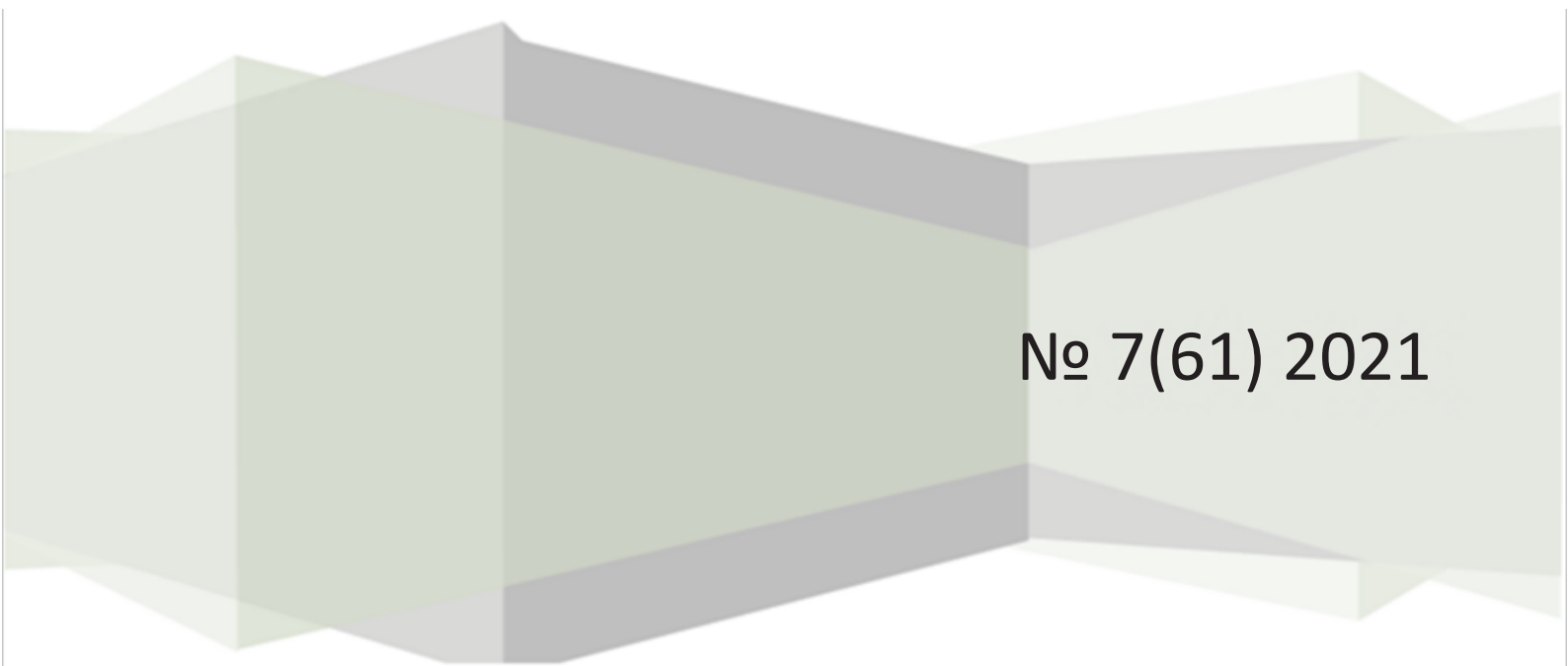


ISSN 1997-9347

# Components of Scientific and Technological Progress

*SCIENTIFIC AND PRACTICAL JOURNAL*



№ 7(61) 2021

Paphos, Cyprus, 2021

Journal "Components  
of Scientific and Technological  
Progress"  
is published 12 times a year

**Founder**  
Development Fund for Science  
and Culture  
Scientific news of Cyprus LTD

The journal "Components of Scientific  
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UDK 62-5

## Application of the Intelligent Field Information System for Effective Oil Production Management

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**Key words and phrases:** applied software products; intelligent field.

**Abstract.** The aim of the paper is to study the intelligent field information system for the effective management of an oil industrial company. The hypothesis is the assumption that the use of an intelligent field information system significantly improves the operational data collection from all industrial facilities of the field, the processing of all collected data and their analysis to optimize operational decisions. The article discusses in detail the components of the subsystem of an intelligent field: air flight systems; a mobile employee control system, the “Electronic chess” system, a remote video monitoring system for drilling, the “Region-2000” system and other systems. The study confirmed hypothesis of the research.

In 2013, Rosneft Oil Company was the first in the domestic industry to implement the “Intelligent Field” system. This is done to efficiently use the well stock to reduce operating costs.

The project involves remote control of production, makes it possible to promptly correct actions online, predict the state of the field, improve energy efficiency, efficiently manage personnel, and also use unmanned aerial vehicles around the clock to monitor facilities.

The main reasons for the implementation of the real-time production optimization process at the Samotlor field were the following factors:

- a large stock of wells;
- an increase in production areas (on average from 400 to 800–1,000 wells);
- reduction in the number of personnel after the merger of workshops and enterprises (on average by 10–15 %), and, as a result, an increase in the overload of geological and technological personnel;
- data was stored in an unordered way in different systems;
- predominantly reactive approach to solving the problem.

The intelligent well system consists of many subsystems: air flight systems; a mobile employee control system, an electronic chess system, a remote video monitoring system for drilling, the Region-2000 system and other systems.

The air monitoring system helps to monitor pipeline routes and oil production facilities of Samotlor Field. About 30 routes have been developed for unmanned aerial vehicles. The time spent in the air is up to four hours, the range with real-time data transmission is up to 50 km.



Fig. 1. Fields of application of unmanned aircraft in the oil industry

In the arsenal of the enterprise there are ten aircraft of the aerial type (Fig. 1). The entire infrastructure is subject to online control: about six thousand linear pipelines and more than two thousand site facilities. Flights are carried out around the clock.

In addition, the enterprise has the “Mobile employee” control system, which enables to control and monitor the work of operators, pipeline crawlers. A special device with a GPS tracker allows you to record their movement at production facilities. In case of an emergency, the “SOS” alarm button is provided, which significantly increases the level of security.

The “Electronic chess” designed to automate the collection, analysis and processing of operational information of geological and technological services, enables to optimize the activities of the enterprise at almost any stage of the production process. Now the data is processed in real time, and not as before after a while.

The system of remote video monitoring of drilling allows you to remotely monitor the process of well construction, collect and analyze operational information in real time, coordinate the work of personnel employed at bush sites. All-important geological, technological and production information from drilling rigs is collected in real time. The monitoring center operates around the clock, and practitioners with many years of experience work here as experts. With the help of this program, the efficiency of drilling processes is achieved, the time for making managerial decisions is reduced to a minimum.

In addition to the continuous transmission of the image from the drilling rig, a number of production parameters are also recorded, such as the vibration level, the speed of drilling and rotation of the rotor, the load on the bit, the readings of the washing liquid, gas indications (about thirty parameters). All the received data is formed into diagrams, which are also promptly controlled by the specialists of the center.

Currently, most of the drilling sites of oil and gas enterprises are under close attention. The monitors display a picture of each of these wells on the screen. Cameras installed at the facilities record the entire drilling process, including the work of specialists, on an electronic medium.

The Region-2000 program reads dozens of well operation parameters, such as, for example, the pressure at the pump intake, the active power and many other parameters.

For mature fields, efficient operation is extremely important. Using the production optimization process in real time allows you to increase profitability and extend the service life of the field. This approach is especially relevant for the development of Arctic oil fields, since it allows you to optimize the management of the production process with a minimum number of personnel directly on the spot. Introduction the conditions for the development of an oil field become more complicated over time, both in terms of climate and process. Cost-effective production of hydrocarbons becomes possible only with the use of advanced approaches in asset management.

The introduction of the “Intelligent Field” concept resulted in changing the approach to the design of systems and software for business decision-making processes, and not an investment in expensive equipment. The concept of the entire scheme is remote management of oil and gas production facilities, control of energy consumption, increase in energy efficiency, increase in the efficiency of equipment operation, rational personnel management, transparent information and production automation. Indeed, intelligent deposits allow us to increase production and reduce risks both for the company itself and for its employees.

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## Применение информационной системы «Интеллектуальное месторождение» для эффективного управления нефтедобывающим предприятием

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**Ключевые слова и фразы:** интеллектуальное месторождение; прикладные программные продукты.

**Аннотация.** Целью исследования является изучение информационной системы «Интеллектуальное месторождение» для эффективного управления нефтедобывающим предприятием. Гипотезой является предположение, что применение информационной системы «Интеллектуальное месторождение» значительно улучшает оперативный сбор данных со всех промышленных объектов месторождения, обработку всех собранных данных и их анализ для оптимизации оперативных решений. В статье подробно рассмотрены составляющие подсистемы интеллектуального месторождения: системы воздушных полетов, системы управления «Мобильный сотрудник», система «Электронная шахматка», система удаленного видеомониторинга бурения, система «Регион-2000» и др. В результате изучения поставленной проблемы была подтверждена выдвинутая гипотеза.

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UDK 72.01

## Cartographic Method of Selecting Architectural Monuments for Art History Excursion Programs

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**Key words and phrases:** maps; architectural objects; methodological approaches; excursion program.

**Abstract.** The purpose of the article is to reveal the possibilities of the cartographic method, to determine the advantages and features of new, including online maps, which help in the professional work of a guide for competent and interesting building of the route of excursions and identifying important architectural monuments involved in it. The objectives of the study relate to a range of issues related to the identification of currently existing types of maps with architectural monuments fixed on them and modern objects applied. Consideration of their specifics, topographical and art criticism analysis of historical stylistic phenomena. Traditional and new maps with architectural objects included in them are considered as a cultural and educational component of the excursion route. Attention is drawn to their informative content; a brief method of application is given. With the help of maps one can assess the versatility and attractiveness of the route for different segments of the population and age groups. Old and new maps show that, using a well-chosen type of map, guides the guide in the selection of objects and the nature of the displayed material. Maps depicting monuments and modern architectural structures can be considered in the perspectives of development of both domestic and international tourism.

### Introduction

The relevance of the problem is due to the need to reconstruct the general meaning and content of the cartographic method in the context of architectural heritage and modern excursion practice, which is of interest to tourists as an internally unified potential system formed in the field of interaction between geography and art. Today, the range of development of tourist routes is mainly limited to traditional maps of cities and their centers, on which architectural objects are only indicated, but no more detailed information about them is given.

The information for tourists on modern maps and in atlases of different countries and

regions, presented by different manufacturers, is basically uniform. The main attention is focused on groups of objects representing communications, tourist services and offices. Places of interest (monuments, museums, parks, exhibitions, etc.) are presented without special systematization and strict approaches to the image [1, p. 175]. It is known that (historical and cultural monuments) are divided into types: monuments, ensembles and places of interest and categories of historical and cultural significance: federal, regional and local (municipal) significance. For a tour guide, determining the significance of cultural heritage objects (monuments and history and culture) established by law is not possible without determining their historical and cultural value, conducting their comparative analysis, which cannot be carried out through such traditional maps.

### **Methods and materials**

Today, the method of fixing an architectural structure on the map plan is quite limited, since the object appears in it as a sign indicating only a topographic place, but not transmitting a certain thought of the guide. The guide has to identify the most valuable of the heritage of the past, which has survived to the present time, by referring to additional printed text sources and archival data. The most important semantic content for excursion programs is acquired by architectural dominants that have developed in a particular country, on a particular territory and in a particular region.

The cartographic method is aimed at identifying the geography of the distribution of certain types of architectural monuments, studying historical stylistic phenomena “in space and in time”. This strategic method is more mobile and is not designed for long-term research. The mapping itself can be carried out according to ethnic, territorial, and temporal principles and allows you to trace the prevalence of monuments and architectural formation among different peoples in different periods of their history. The study of architectural objects by mapping requires a lot of preparatory organizational and collecting work, and, as a rule, needs the association and coordination of specialists. First, a mapping program is drawn up beforehand, the research is carried out to identify and systematize the available materials, gaps are identified, special maps are drawn up, and principles of applying materials to the map are developed [2].

### **Results**

The maps of the historical center of the city with its main attractions are important for tourists, since it is in the central zone of the old cities that the main architectural objects are mainly concentrated. They contain the description of the architectural ensemble.

Maps showing a single architectural ensemble or monument with drawings of individual elements – facades, window and door openings, domes, ceilings, towers, spires, decor and other elements are convenient for visual perception and representation of the compositional structure of structures. This approach leads to the display of the functional content of the architectural monument, the tectonic features of the building, the nature of its constructive solution.

Architecture is a space-time art consisting of separate motifs and forms combined in the appearance of one building. The more extensive and complex the spatial complex is, the more complex is the mechanism of its perception as an integral spatial and figurative system. Such maps can help the guide choose the best direction of movement, determine the most expressive points of view on the object.

Local specialized maps are created for the organization of individual or specialized excursions of a narrower subject. For example, there are maps dedicated to specific historical periods and architectural styles (Moscow Empire, St. Petersburg Baroque, Riga Art Nouveau). Starting from the origins of architecture, there was a combination of styles and directions. In addition, not all significant features of the era style may be present in one territory, they may be expressed with different strength. In this case, the architectural space is comparable to a field where the voltage changes from the polar points to the periphery. The objects can be arranged in different ways, concentrated in the central zone or scattered over sufficiently distant distances, lined up in rows according to the degree of increase or decrease of the stylistic feature. Their use in the excursion analysis characterizes the specifics of the artistic image, its interaction with reality.

In 2020, online maps have gained a new value – they enable to study architecture around the world, all the more relevant now that entry restrictions continue to apply in many countries [3].

The use of maps is not new, since they have long been used. In modern tourism, it is a method that makes it possible not only to build an excursion route, but also to create a sense of the upcoming discovery of the beautiful, waiting for tourists.

Maps with detailed content and large-scale atlases give an idea of the true size of the existing architectural structures. They show the regions with the quantitative designation of buildings. Thus, the map of the “people’s” Archilovers project is a plan-scheme on which anyone can add objects. There are 200 thousand architectural projects on this map.

Similar informative maps are being developed to give an idea of the true scale of modern architecture - buildings in cities from Moscow to Vladivostok, on landscapes from the Murmansk tundra to the shores of the Caspian Sea. They contain photos of different years, sometimes even from the same angles. According to them, it is easy to compare how much the exterior of a particular building has changed. Not only the authorship and the year of construction of the objects are indicated, but also their current status and status.

The most unusual of the previously considered graphic maps is the map that became part of the “Architecture of the Seventh Day” project, within the framework of which architects and researchers K. Snopek, K. Popera and I. Chikhonska studied the phenomenon of churches built in Poland in the twentieth century. The schematic model of the map is the same as that of the last two, but its narrower orientation allows it to be considered as an invariant in the typological planning scheme. The map was created by the architects of the Brazilian bureau Sguizzardi Coelho Arquitetura. Initially, it was part of their training project, but then it developed into an independent professional service.

Another new type of map is dedicated to the phenomenon of “monuments”. In an international context, it contains more than a hundred detailed descriptions with historical photos, deciphering symbols and recommendations for visiting. The individual uniqueness of the monuments is woven into the fabric of this map. Its ideographic content places in the focus of attention a unique architectural and artistic object as a phenomenon, but correlated with the typological background of its general content. The unique originality is read in the geographical location, the aesthetics of plastic shaping, in belonging to a historical epoch, in tectonic preference. Such maps construct a systematic, though not complete picture of the spatial and temporal distribution of styles in different regions of the world.

Even more detailed content is an analogue of Wikipedia in the cartographic version. One of the most interesting categories is the “Historical layer”, through which one can see the disappeared objects, information about which can also be included in the excursion programs. In many regions of our planet, only ruins, fragments of foundations have reached us, and

some have gone into the layers of the earth. Architectural monuments discovered as a result of archaeological research are interesting material for tourists, it displays a spatial and temporal map of the cultural development of various countries of the world. The complex trajectory of the narrative is set here by the internal logic of archaeological knowledge with the general direction of the excursion theme.

The so-called Building Age Maps show the construction dates of all buildings in a particular city. Every year it is supplemented. A recent map of St. Petersburg, a map of Paris with a periodization of its development, Barcelona, and other metropolitan and peripheral cities can serve as confirmation. And in the Netherlands, they went even further and noted the age of buildings throughout the country. The proposed chronological interpretation of architectural monuments allows us to look at them from a slightly different angle - within the limits of historical art history.

The most popular map in the world is created for building routes and searching for information. Experts believe that the task of each region is to create a so-called flagship route – the one which is the basis for the formation of various tours with different topics. The creation of a flagship or base route in the region is an important strategic decision that will allow you to apply for the inclusion of the region's display objects in an interregional (branded) route [4, p. 7]. The initial situation in working with this map is the definition of an ideological plan that corresponds to the real life material and is quite specifically focused on its interpretation. Further, the guide's idea is concretized by the choice of a topic. The flexibility and variety of the architectural language allows you to choose a specific aspect of the future excursion, to determine its ideological content. Compilers of tourist programs are recommended to turn to such a map last of all – only after they know exactly what they need to find.

Panoramic 3D maps of megalopolises are interesting and unusual. They are associated with the implementation of projects in the countries and are mainly associated with the point digitalization of individual urban services and infrastructures. Urban planning today needs to ensure a qualitative transition to smart urban planning design – from BIM modeling of individual buildings to modeling of urban spaces (City Information Modeling), i.e. to create a digital information system for managing urban development. Such a system should include a digital dynamic general plan of the territory, as well as such elements of a "Smart City" as urban transport management based on artificial intelligence technologies [5]. On such maps, it is not the disparate architectural structures that are of great importance, but the mass character, the orientation to an integral urban space, understood in the context of a mobile, actively developing system. They reflect the desired universal model of modern architecture, on which great hopes are placed, which covers the most important social and cultural determinants of artistic phenomena. With its searches, modern architecture can be attractive for inclusion in sightseeing tours, as it has value as an interesting experiment in the field of architectural language.

### **Conclusion**

The considered maps were created in architectural bureaus, a number of them by individual specialists. They have become a turning point in the work of the guide, as they allow us to determine the cultural-historical, stylistic and typological features of architecture and individual monuments of different countries, as well as to identify during the analysis the cultural characteristics of countries located far from the location of the beginning of the excursion route. With the help of maps, you can assess the versatility and attractiveness of the route for different segments of the population and age groups. The accumulated range of old and new maps that

have been published today shows that, using a well-chosen type of map, a guide can resort to others, depending on the individuality and nature of the material, Maps showing monuments and modern architectural objects can be considered in the prospects for the development of both domestic and international tourism.

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### Картографический метод отбора памятников архитектуры в подготовке искусствоведческих экскурсионных программ

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**Ключевые слова и фразы:** архитектурные объекты; карты; методологические подходы; экскурсионная программа.

**Аннотация.** В статье поставлены цели: раскрыть возможности картографического метода, определить преимущества и особенности новых, в том числе онлайн-карт, помогающих в профессиональной работе экскурсовода грамотному и интересному выстраиванию маршрута экскурсии и определению важных архитектурных памятников, в ней задействованных. Задачи исследования касаются круга вопросов, связанных с выявлением существующих на сегодняшний день видов карт с зафиксированными на них архитектурными памятниками и нанесенными современными объектами; рассмотрением их специфики, топографическим и искусствоведческим анализом исторических стилевых явлений. Традиционные и новые карты с включенными в них архитектурными объектами рассматриваются как культурно-познавательная составляющая экскурсионного маршрута. Обращается внимание на их содержательный контент, дается краткая методика применения. Достигнутые результаты: с помощью карт можно произвести оценку универсальности и

привлекательности маршрута для разных слоев населения и возрастных групп. Старые и вышедшие в свет новые карты показывают, что удачно выбранный тип карты ориентирует экскурсовода в отборе объектов и характере демонстрируемого материала. Карты, отображающие памятники и современные архитектурные строения, могут рассматриваться в перспективе развития как внутреннего, так и международного туризма.

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UDK 65.01.007

## Implementation of Company Management Variability at the Stage of Its Formation

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**Key words and phrases:** adaptive organizational structure; hierarchical organizational structure; life cycle; organizational structure.

**Abstract.** As any other economic sector in market conditions, the construction industry is characterized by the processes of continuous change. These processes are accompanied by the formation of new companies and the departure of companies that failed to adapt to the new conditions. The purpose of this study is to consider the impact of the management approach used by the company on the formation and development of the organizational structure at the stage of company's formation. As a hypothesis, it was suggested that the primary is the choice of management approach, which, depending on the volume and specificity of products, the number of employees and aims of the company, determines the list of practically possible organizational structures. When performing the study, the authors relied on methods of system analysis and synthesis, as well as on the provisions of the organizational management theory. As a result of the study, recommendations on the practical application of a particular combination of organizational structure and management approach were formed.

Serious challenges, which Russian enterprises and organizations of construction and related economic sectors have faced, clearly demonstrate the fact that the problem of organization management mechanism improvement remains quite relevant. This is confirmed by the visible changes in the construction market participants, associated with the departure of previously successful players and their replacement by new companies with more flexible approaches to business management.

In this connection the interrelation of lifecycle stages and company's organizational structure seems to be quite important and well-timed for the authors.

Earlier [1] we've reviewed the process of forming an organizational structure during the first stages of company's lifecycle based on Adizes model (Fig. 1) [2].

We have also described the main aspects of functional and process approaches to management and defined the possible combinations of approaches and organizational structures (Fig. 2).

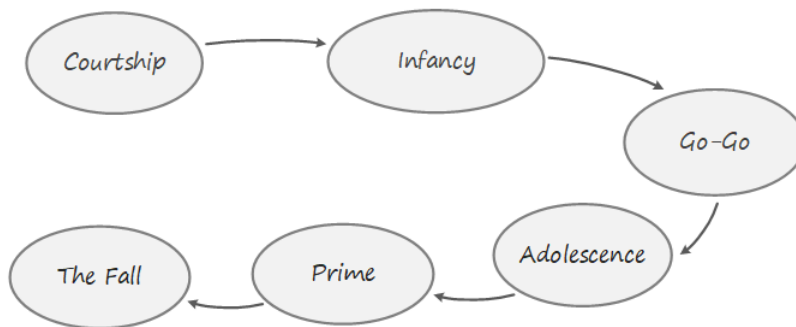


Fig. 1. Part of Adizes organizational lifecycle model

Management approach	Organizational structure				
	Hierarchical	Project management			
		Matrix			Project
		Weak	Balanced	Strong	
Functional	1	2	3	4	5
Process	6	7	8	9	10

Fig. 2. Possible combinations of management approaches and organizational structures

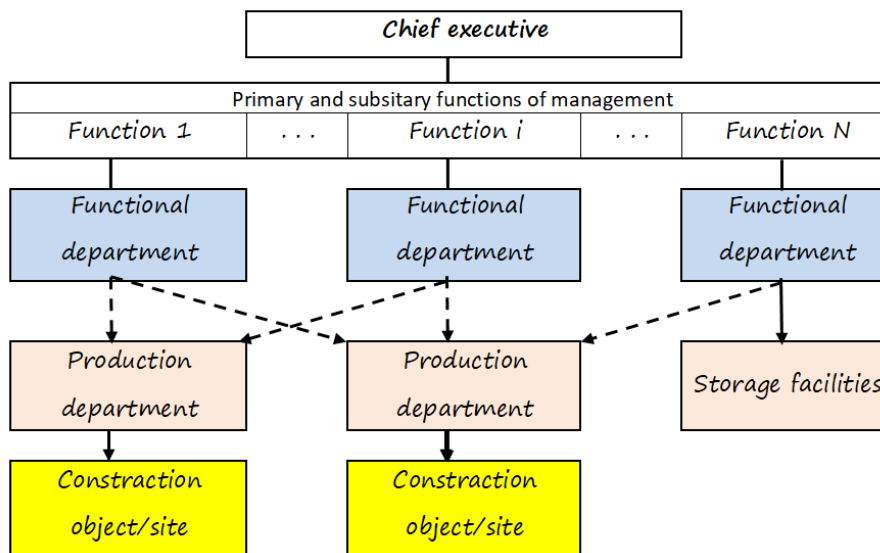


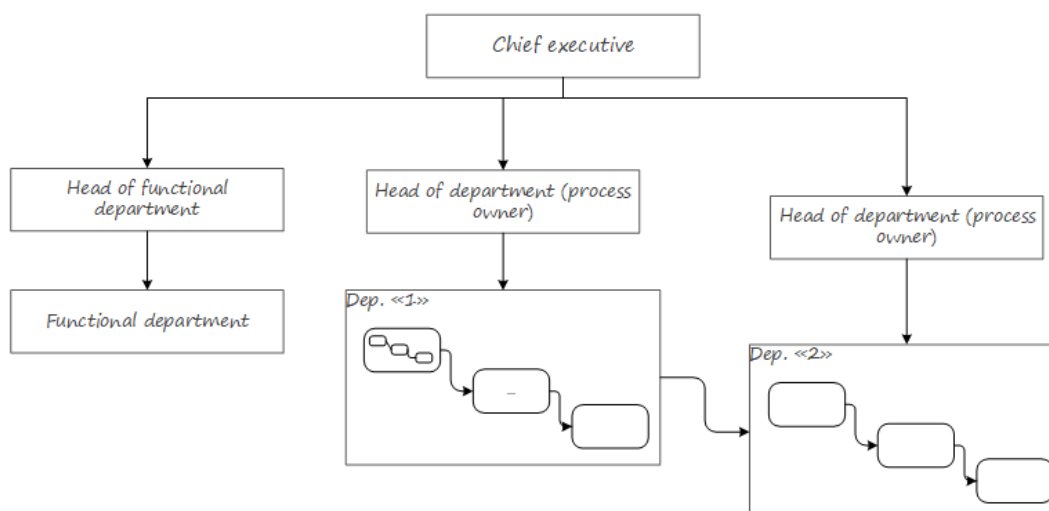
Fig. 3. Functional approach and line-staff structure

Taking a closer look at the presented options we'll assess the viability and rationality of each of them.

Option 1 combines functional approach and any kind of hierarchical structure, mainly the line-staff type (Fig. 3).

A line-staff is a classic bureaucratic structure that consists of two groups of departments:





**Fig. 4.** Hierarchical organizational structure in process management

production and management (functional). The first group is responsible for manufacturing goods while the management's task is to make decisions that would increase the production's efficiency and provide the resources. The heads of functional departments are responsible for communication between their departments and with the production departments as well. Within the department the most common organizational structure is the line structure, which means each employee has one superior.

As for construction industry, we believe this option would work best in the companies that make products of steady demand or construct buildings of typical design. It can also be used for sub-contractor organizations whose list of services is quite limited and specialized.

Options 2–4 combine functional approach and matrix structures. There are two chains of command in a matrix structure – project management and a functional line. The more decision-making power a project manager has over a functional manager the “stronger” the matrix is. However, if the functional management only is used, the matrix structure would not be suitable. The contradictions between the principals put in allocation of responsibility in functional management and matrix structure are the reason to that. As it was mentioned before in functional management the delegation of responsibility is based on groups of similar operations while the matrix is formed based on the stages of the project. The eventual success of the company depends on how well the project can go through these stages – considering both time and quality. So that leads to the necessity of focusing on managing the project more than managing functional departments.

Implementation of a project management structure in functional management (option 5) has lately gained popularity in micro and small companies. In this case the temporary structure (a team) is formed with the employees of different departments. The goal of this team is to complete the task that the company sees as a project. The team members are subordinate to the project manager while it is in process. After the project is completed, they go back to their departments. It's also common to recruit contractors for the stages of the project while the company's employees form the project management team.

Moving on to options 6–10 assuming the company's approach is process management with all its pros and cons [4].

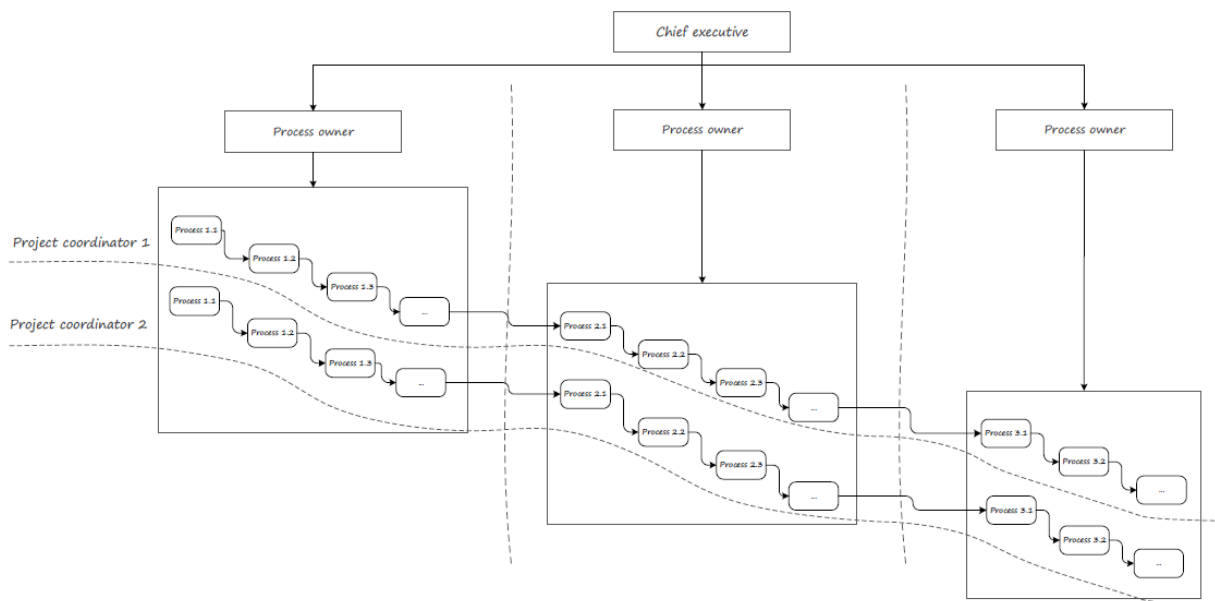


Fig. 5. Weak matrix structure

Option 6 demonstrates the given approach in combination with hierarchical organizational structure (Fig. 4).

The departments are formed based on company’s business processes that include management and production. The owners of business processes become heads of departments. Each department consolidates employees who are responsible for subprocesses and are subordinate to the head. At the same time there usually are departments that are not involved in production. They can be formed based on their functions (e.g., human resources) or allocation of the “service processes” (e.g., legal support management) [5].

Options 7–9 specify process approach within project management in the companies with matrix structures. Depending on allocation of responsibility between a head of department and a project manager the matrix can be “weak”, “balanced” or “strong” [6]. Each of them will be described below.

“Weak” matrix would be the most efficient in the companies whose projects are typical and standard. These projects have similar operations that are organized as a flow and are completed smoothly. Operations form the processes that the departments are based on. The project manager’s job comes down to project coordination and communication with the customer (Fig. 5).

“Balanced” matrix is more flexible – every project is considered as a set of stages; each stage is a process. The head of department (process owner) assigns a department member for each process. Running the project is a standalone job performed by a project manager. After each process is completed the head of the department approves the result and the project manager forwards it to the customer or to the entry of the next process (Fig. 6).

If the combination of circumstances and project requirements is unique every time, it’s reasonable to form a “strong” matrix structure (Fig. 7). Meanwhile the processes in the projects are still quite similar. In this case the particular result of the stages of each project and the product itself are unique.

Project manager has quite a lot of authority and holds full responsibility for the project.

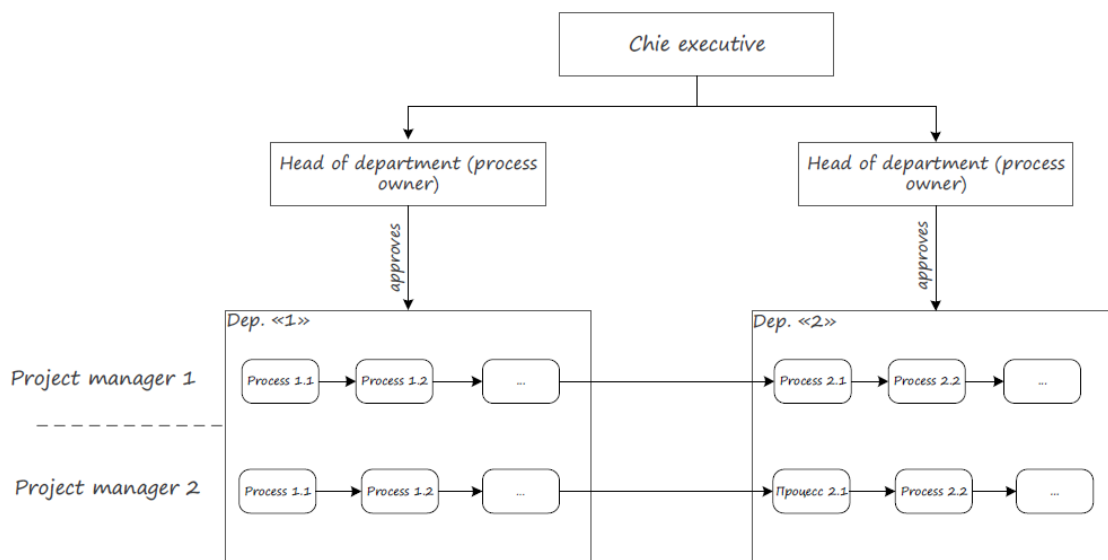


Fig. 6. Balanced matrix structure

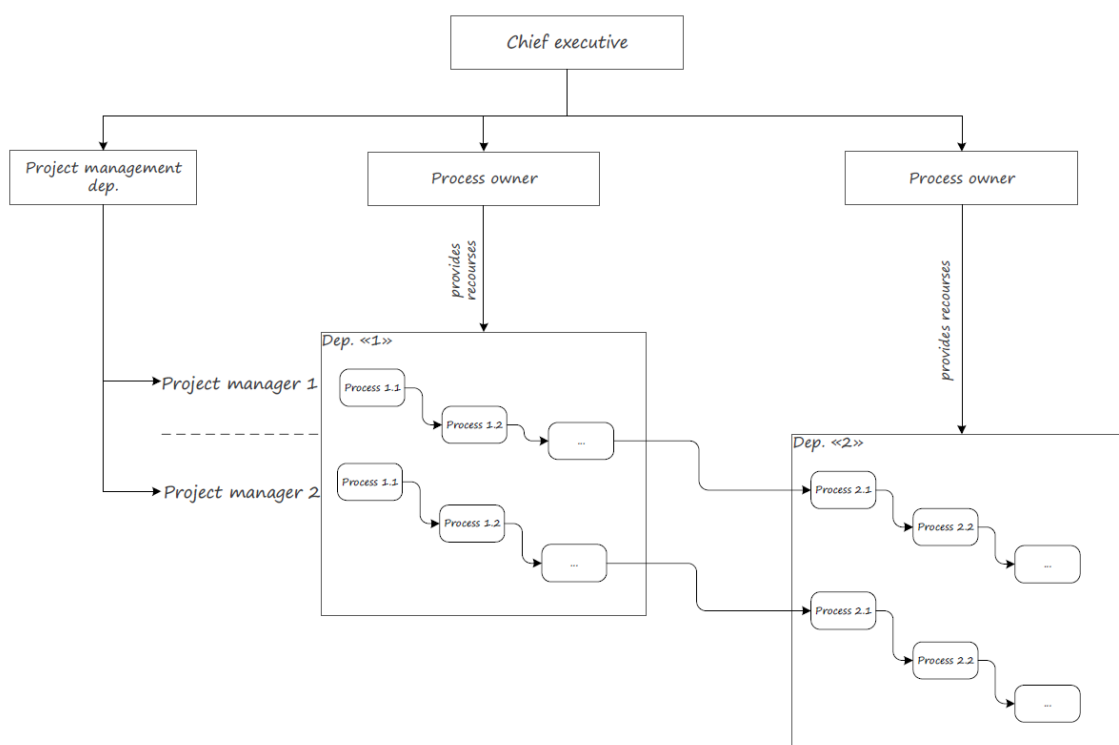


Fig. 7. Strong matrix structure

The other employees are subordinate to the heads of their departments. It's also common to form a separate department that manages the projects (project management department). That enables to perform complex projects.

And finally, option 10 describes process management in project structures (Fig. 8).

Project structure is created for major, technically and/or organizationally complex projects.

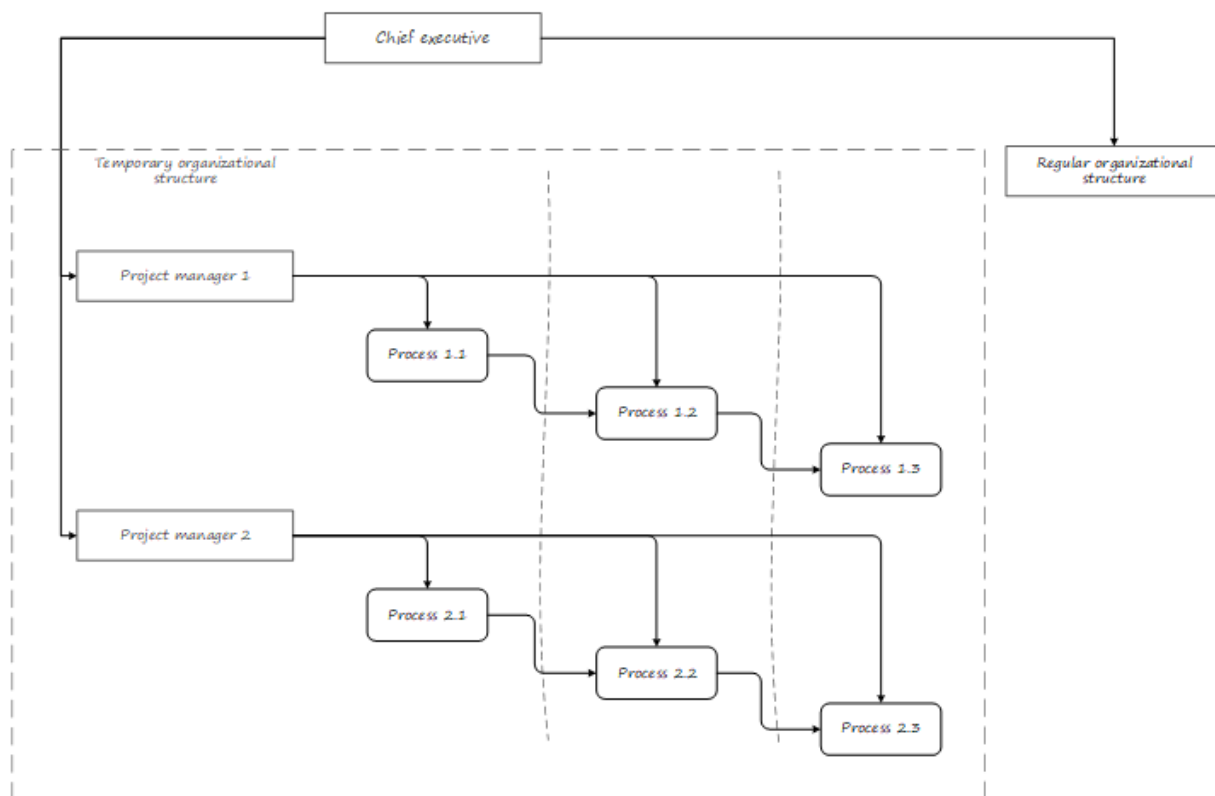


Fig. 8. Project structure

These projects are usually at priority and have a significant impact on the company’s reputation and market position. The key person in these projects is project manager, who has absolute decision-making power and is responsible for planning and control. The project is divided into stages that are managed as processes. Project manager defines the roles and allocates the responsibility.

All of this leads to the necessity to provide the required recourses at the scheduled time. Sometimes the company might not have enough recourses; then extra resources are engaged from the outside (e.g., specialists, partners). So we see that there is a project team that is formed temporary; after the project (or its part) is completed it is dismissed and the employees go back to their departments.

There can only be a few projects like mentioned at the same time. They are performed separately from each other and the company’s main activity such as typical projects or serial production.

Mentioned structures can be combined together within one company. E.g., there is a matrix structure for the main flow of projects, and a separate structure can be temporary formed for occasional complex projects that work independently under the management of project manager.

Summing up, we can say that organizational structure is formed based on company’s specialization on the market; and the connections between departments and staff are defined by the approach to management and can more or less include both functional and process aspects.

The apposite combination of the proper type of organizational structure with a chosen management approach leads to increasing company’s flexibility and efficiency.

We'd also like to point out that adolescence is the stage when the company should explore new possibilities and prior experience and feel free to experiment in order to find the best management mechanism.

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### Вариативность реализации механизма управления компанией на этапе ее становления

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**Ключевые слова и фразы:** адаптивная структура; жизненный цикл; иерархическая структура; организационная структура управления.

**Аннотация.** Строительству, как и любой другой отрасли экономики в рыночных условиях, свойственны процессы непрерывного изменения, сопровождающиеся появлением молодых компаний и уходом компаний, не сумевших приспособиться к новым условиям. Целью данного исследования является рассмотрение влияния используемого руководством компании подхода к управлению на формирование и развитие организационной структуры на этапе становления компании. В качестве гипотезы выдвинуто предположение о том, что первичным является выбор подхода к управлению, который в зависимости от объема и специфики выпускаемой продукции, численности и целей организации

определяет перечень практически возможных организационных структур управления. При выполнении исследования авторы опирались на методы системного анализа и синтеза, а также на положения теории организационного управления. В результате работы сформированы рекомендации о практическом применении той или иной комбинации организационной структуры и подхода к управлению.

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UDK 658

## The Use of Big Data in Business to Strengthen the Competitiveness of an Organization

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**Key words and phrases:** big data management; competition; digital technologies; organizations.

**Abstract.** The purpose of this article is to study the impact of Big Data technology on the activities of businesses. To implement the research goal, the following tasks were formulated: to assess the global and Russian Big Data market, as well as the leading market players; to consider the differences between Big Data analysis and traditional business intelligence; to study the experience of using Big Data technology in various sectors of the economy, as well as in the activities of organizations. A hypothesis was formulated about the impact of Big Data technology on improving the efficiency of entrepreneurship and increasing the competitiveness of businesses. The research methodology is based on the methods of comparative and systems analysis, firm economics, management theory. The analysis made it possible to obtain the following results: the differences between Big Data and conventional business intelligence have been identified; the techniques and methods of big data analysis that are used by organizations to solve managerial and production problems have been considered. The conditions for the successful implementation of Big Data projects in the activities of business organizations are proposed. It was revealed that companies that have implemented a high culture of working with Big Data achieve the greatest success.

Currently, digital technologies are changing the lives of people, organizations, and states. Companies and organizations are actively introducing mobile and cloud technologies, the Internet of Things, artificial intelligence systems, and others into business processes. Big Data provides new opportunities for development. Big Data technology accelerates innovation processes in the field of analytics in the public sector, science, and business organizations [1].

Practice shows that the use of Big Data for decision-making allows managers to radically rethink approaches to the development and implementation of an organization's strategy. Companies are now showing great interest in Big Data. Many of them incorporate Big Data into

**Table 1.** Information sources for work on database technology in the company

Internal sources	External sources
Centralized and local databases (regulatory and reference information, classifiers, financial information, marketing, etc.	Information from state bodies Industry information
ERP-systems	Social networks
CRM-systems	Internet sources

**Table 2.** Differences between Big Data and Business Intelligence in Companies

Big Data	Business Intelligence
Huge amounts of information	Limited amounts of information
High rate of change of incoming data online, which requires in-depth analytics	The information reflects the past activities of the company and the actual state at the time of analysis
Unstructured data of different types and not always clear possibilities for their processing	Standard data of uniform types and well-known analytical tools for processing them

business models as a strategic resource.

Big Data is changing the way executives think about how organizations operate. Big Data provides information that provides new insights into business processes and enables more effective and better management decisions.

At the same time, it should be understood that the benefits of Big Data require new approaches to the analytical tools used in organizations, technologies, business processes and staff [2].

Experts from the McKinsey Institute define Big Data as datasets that are larger than conventional databases and are complex in terms of storage, analysis and management [5].

In fact, Big Data technology involves the organization of work with huge amounts of information that comes from different sources (video, audio, geolocation, etc.) and has a high degree of renewal. Possible types of information sources that are used in companies to work on Big Data technology are presented in Table 1.

What is the difference between traditional business intelligence, which is used by companies to solve management and operational problems, and Big Data analysis?

According to world renowned Japanese information and communications technology company Fujitsu [5], traditional business intelligence enables executives to solve problems based on evidence, while Big Data technologies enable them to solve predictive problems. Table 2 summarizes the differences between Big Data and business intelligence.

According to experts from Oracle [5], the Big Data technology differs from standard analytics, when the results are obtained using standard mathematical / logical operations.

In the process of working with the database, they are sequentially cleaned in accordance with a certain model according to the following stages:

- putting forward a hypothesis;
- building an actual model and testing it for compliance with the hypothesis.

If the hypothesis is not confirmed, then the process is repeated again.

According to Research And Markets, at the end of 2019, the global market for Big Data



analytics is \$ 41.85 billion. In 8 years the market will grow to \$ 155.13 billion. Growth will average 11.9 % per year.

The basis for the use of Big Data technology is cloud platforms that allow you to develop applications for working with Big Data.

Major companies use their own or hybrid clouds, small and medium-sized companies mainly use public clouds.

Small and medium-sized companies that do not have the resources and capabilities to independently implement Big Data projects use **BBDaaS** (Big Data as a service) technology, which is a cloud computing platform integrated with Big Data.

BBDaaS technology allows companies not only to save resources, but also to quickly solve analytical problems of Big Data in the cloud, giving all departments access to data at any time.

In January 2020, the European Union announced its intention to create a single Big Data market that will compete with the dominance of American and Chinese companies in the Big Data market.

According to experts from Frost & Sullivan, the global database market in 2021 will show an increase of 2.5 times compared to 2016 and will amount to 67.2 billion US dollars [6]. The average annual growth rate will be 35.9 %. Promising segments of the database market will be: manufacturing, financial sector, medicine, retail, environmental protection.

According to Research And Markets, the BDaaS market was \$ 4.99 billion in 2018. The largest players in the BDaaS market are Amazon Web Services, Hewlett Packard Enterprise, IBM, Microsoft, Oracle, SAP, Teradata, Google, Accenture.

According to experts' forecasts, the global BBDaaS market will grow to \$ 61.42 billion by 2026. The average annual growth rate will be 36.9 %.

The analysis shows that the further growth of Big Data technologies will continue due to the following factors:

- the increasing accumulation of unstructured data arrays by companies;
- development of systems based on artificial intelligence (**AI**) and the Internet of things (**IoT**);
- growing demand for data mining and predictive analytics [3].

Currently, database technologies have already found wide application in the modern economy. Let's consider some of the results of using the database in some sectors of the economy (Table 3).

Currently, a large number of analytical tools are used that are used for database analysis. These include: data mining, artificial neural networks, simulation, analytical data visualization, crowdsourcing, data fusion, cluster analysis, machine learning, predictive modeling and analytics, spatial analysis, etc. [4].

The world's leading IT companies are developing projects related to Big Data. Among them: Amazon, Dell, Facebook, Fujitsu, Google, IBM, HP, Linkedin, Microsoft, SAP, Yahoo, etc. Big Data is formed in the course of the functioning of these companies. By developing software for Big Data analysis, companies attract new customers and enter new market segments.

Analysis shows that Big Data is becoming part of the value chain of companies and increasing their competitiveness in the market.

As the experience of large companies – technology giants: Apple, Google, Facebook and others shows, they have achieved market success thanks to a strategic approach to data analysis and effective use of Big Data. Their strong competitive position is based on their ability to use Big Data in market strategy.

Table 3. Use of Big Data in sectors of the economy.

Industry	Big Data tasks	Efficiency
Financial sector/banks	<ul style="list-style-type: none"> <li>• Monitoring of credit risks</li> <li>• Counteracting fraud and money laundering</li> <li>• Compliance, internal control</li> <li>• Internet trading</li> </ul>	Growing customer loyalty and increasing the customer base
Telecommunications	<ul style="list-style-type: none"> <li>• Prevention of customer fraud</li> <li>• Conducting large advertising campaigns</li> <li>• Improving the quality of communication, etc.</li> </ul>	Increasing competitiveness
Retail	<ul style="list-style-type: none"> <li>• Analysis of the conjuncture of commodity markets</li> <li>• Forecast of changes in prices for certain goods</li> <li>• Forecast of changes in consumer demand</li> <li>• Personal marketing campaigns for clients, etc.</li> </ul>	Growing operating profitability
Energy	<ul style="list-style-type: none"> <li>• Implementation of IoT technologies</li> <li>• Online monitoring of outages</li> <li>• Determination of supply and demand for electricity in the market, etc.</li> </ul>	Increased efficiency of power generators
Medicine	<ul style="list-style-type: none"> <li>• Monitoring of treatment measures</li> <li>• Optimization of patient care</li> <li>• Forecasting the occurrence of epidemics, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Monitoring of treatment measures;</li> <li>• optimization of patient care;</li> <li>• forecasting the occurrence of epidemics, etc.</li> </ul>
Urban economy	<ul style="list-style-type: none"> <li>• Achieving optimal consumption of water and electricity</li> <li>• Optimization of urban transport traffic</li> </ul>	Reduced energy and water costs

It is known that, in contrast to the traditions of Microsoft and IBM, in Apple technologies for the production of computers, operating systems and devices, developed in parallel and sequentially. It was a response to the next challenge of the digital age. Having reached the next limit in a separate direction, it was necessary to go further, using the accumulated arrays of data on demand, guided by consumer sentiment and having a new marketing strategy.

Apple has accumulated data over the years on how consumers are using Apple devices, how consumer tastes and preferences are changing, and changes in demand. This allowed the company to successfully adapt to changes, strengthen its competitive position in existing markets, and enter new markets. Thus, the emergence of the App Store, iTunes, as well as iPad and iPod devices allowed the company to take positions in the markets of music products, games, e-books and magazines, pushing out traditional players.

The analysis shows that with the introduction of digital technologies, consumer behavior in relation to companies is changing:

- increasing requirements for quality and service, provided goods/services;

- the need to access the product/service 24/7;
- variety and a large amount of available information about the product / service online;
- ensuring a high emotional level in interaction with companies.

Keeping in mind the increased demands of consumers has also prompted companies to use Big Data to create diverse models of interaction with them. At the same time, consumers are active elements of such models, leaving their feedback on companies, products/services in social networks, on company websites, participating in chats, forums, communities.

The analysis shows that a number of factors hinder the successful implementation of Big Data projects in the activities of business organizations. Let's take a look at some of them:

- miscalculations in the development and organization of a Big Data project;
- the functionality of the project is not sufficiently developed;
- weak team of analysts;
- resistance to innovations from employees and management;
- lack of a culture of decision-making by managers based on Big Data analysis.

In addition, it is important that companies become more active in using industry-standard cloud-based database solutions from specialized vendors. In practice, many business organizations strive to create their own cloud infrastructure, which does not always work effectively.

The results of the analysis lead to the following conclusions:

- Big Data technologies are one of the key tools to improve the efficiency of organizations;
- the successful use of Big Data for decision-making helps to strengthen the market position of companies;
- the benefits of using Big Data are for companies that create and maintain a high culture of working with Big Data. This means that Big Data must be intelligently embedded in relevant business processes. Subdivisions should be formed, employees who are responsible for the completeness, timeliness and quality of the received Big Data should be determined.

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## Применение больших данных в предпринимательской деятельности для усиления конкурентоспособности организации

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**Ключевые слова и фразы:** конкуренция; организации; управление большими данными; цифровые технологии.

**Аннотация.** Целью данной статьи является исследование влияния цифровой технологии больших данных на деятельность бизнес-организаций. Для реализации цели исследования были сформулированы следующие задачи: провести оценку мирового и российского рынка больших данных, а также ведущих игроков рынка; рассмотреть различия между анализом больших данных и традиционной бизнес-аналитикой; изучить опыт использования технологии больших данных в разных отраслях экономики, а также в деятельности организаций. Была сформулирована гипотеза о влиянии технологии больших данных на повышение эффективности предпринимательской деятельности и рост конкурентоспособности бизнес-организаций. Методология исследования основана на методах сравнительного и системного анализа, экономики фирмы, теории менеджмента. Проведенный анализ позволил получить следующие результаты: определены различия между большими данными и обычной бизнес-аналитикой; рассмотрены техники и методы анализа больших данных, которые применяются организациями для решения управленческих и производственных задач. Предложены условия успешного внедрения проектов больших данных в деятельность бизнес-организаций. Выявлено, что наибольшего успеха достигают компании, которые внедрились высокую культуру работы с большими данными.

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UDK 338

## Factors of Macroeconomic Instability in the Context of the Pandemic

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**Key words and phrases:** coronavirus infection; economic crisis; factors of macroeconomic instability; impact of restrictive measure; pandemic; reduction of business activities.

**Abstract.** In order to study the impact of factors of macroeconomic instability in the context of the pandemic on the reduction of business activity, the paper attempts to consider the main elements of the economic crisis and reflect on their impact. The methods of statistical analysis and economic forecast are used in the study. As a result of the conducted research, a significant impact of restrictive measures taken to prevent the spread of a new coronavirus infection, as well as a decrease in oil prices and a deterioration in foreign trade indicators of economic activity was determined.

There is no doubt that the Russian economy during the 2020–2021 pandemic was simultaneously affected by two powerful factors – a forced reduction in business activity due to restrictive measures taken to prevent the spread of the new coronavirus infection, and a decline in oil prices and a deterioration in foreign trade activity indicators.

Since the restrictive measures of almost all countries of the world in the fight against the spread of coronavirus infection led to a sharp decrease in passenger traffic, especially in the aviation sector, as well as in the use of personal and public transport, this led to a significant drop in global oil demand and the temporary termination of the OPEC+ agreement at the beginning of 2020, the prices of Urals crude oil fell to 41.7 US dollars/bbl instead of 63.6 US dollars/bbl in 2019.

The declining dynamics of oil prices at the beginning of 2020, the outflow of capital from emerging markets (caused by a decrease in risk appetite against the background of a sharp deterioration in expectations of a global economic decline as a new coronavirus infection spreads), as well as the increase in geopolitical and sanctions risks in Russia led to a weakening of the ruble (71.9 Russian rubles per US dollar in 2020 instead of 64.7 Russian rubles per US dollar in 2019).

Containment of the fall in the national currency exchange rate was carried out by the method of conducting operations for the sale of foreign currency within the budget rule and by operations of the Bank of Russia compensating for the lost export revenue from the sale of oil

and gas due to the decline in the Urals oil quotes below US \$ 25 per barrel.

As a result of the economic crisis, the decline in gross domestic product (**GDP**) in 2020 amounted to 3.1 %, and if we do not take into account the negative impact on the economy of the oil and gas sector, which was severely affected by the decline in oil prices and the restrictions under the OPEC+ deal, the economic downturn is estimated at 1.6 %.

The decline in the pace of economic development as a result of the global pandemic began to manifest itself by the end of the first quarter of 2020 against the background of an increase in the scale of its spread in Russia. Although GDP growth slowed down in the first quarter, it maintained a positive trend, reaching the level of 1.6 %.

After the introduction of non-working days in April 2020, the pace of GDP decline accelerated, and by the end of the second quarter of 2020, GDP growth decreased by 8.0 %. Thanks to the implementation of state support measures, the crisis in the economy turned out to be less significant than in other countries (Russia was among the five G20 countries for the smallest GDP reduction in the peak II quarter of 2020). In the second half of the year, as key sectors recovered, there was a slight improvement in the economic situation: the decline in GDP in the third quarter of 2020 slowed to 3.4 % compared to 2021 (–1.8 % excluding the economic decline in the oil and gas sector), and in the fourth quarter the decline is estimated at 2.2 %.

The measurement of individual elements of the GDP structure shows that the main contribution to the decline in GDP growth in 2020 was made by a reduction in final consumption expenditures (–5.2 % after 2.9 % in 2019), caused by a significant decrease in household spending (–8.6 %).

Retail trade turnover decreased by 4.1 % at the end of the year (1.9 % in the previous year). During the quarantine period and the introduction of non-working days, a sharp decline in demand was recorded (–16 % yoy in the second quarter), which was due to the fact that in many regions there were measures restricting the operation of a significant part of non-food stores, the purchase of food products was narrowed to purchases of daily necessities. However, already in the second half of the year, as quarantine measures were lifted and activity was restored taking into account epidemiological requirements, the situation in the consumer sector was steadily improving: the decline in retail trade turnover slowed to –1.6 % and –2.8 % in the III–IV quarters, respectively.

In order to stabilize prices for socially important goods, the Government of the Russian Federation has taken a number of measures aimed at ensuring the balance of key food markets: agreements have been concluded with producers and retail chains, subsidy programs have been introduced, and certain foreign trade measures have been implemented.

The adopted initiatives have helped to stabilize the situation, despite the continued increase in world food prices.

Thus, at the end of 2020, against the background of falling oil prices, a decline in economic activity and the introduction of restrictive measures related to the prevention and elimination of the consequences of the spread of coronavirus infection, partially lifted only by the end of the year, the actual receipt of federal budget revenues amounted to 18,722.2 billion rubles (17.6 % of GDP), which is 1,871.4 billion Russian rubles (9.1 %) less than the estimate provided for by the Federal Law “On the Federal Budget for 2020 and for the planning period of 2021 and 2022”. Oil and gas revenues were received in the amount of 5,235.2 billion rubles (by 2,288.5 billion Russian rubles, or 30.4 % less than the estimate provided for by the Federal Law “On the Federal Budget for 2020 and for the planning period of 2021 and 2022”), and non-oil and gas revenues reached the amount of 13,486.9 billion Russian rubles (by 417.1 billion Russian rubles, or 3.2 % more than the estimate provided for by the Federal Law

“On the Federal Budget for 2020 and for the planning period of 2021 and 2022”) [3].

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### Факторы макроэкономической нестабильности в условиях пандемии

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**Ключевые слова и фразы:** влияние ограничительных мер; коронавирусная инфекция; пандемия; сокращение деловой активности; факторы макроэкономической нестабильности; экономический кризис.

**Аннотация.** С целью изучения влияния факторов макроэкономической нестабильности в условиях пандемии на сокращение деловой активности в работе предпринята попытка рассмотреть основные элементы экономического кризиса и отразить их воздействие. В исследовании использованы методы статистического анализа и экономического прогноза. В результате проведенного исследования определено значительное влияние ограничительных мер, принятых для предотвращения распространения новой коронавирусной инфекции, а также отмечено снижение цен на нефть и ухудшение внешнеторговых показателей экономической активности.

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**COMPONENTS OF SCIENTIFIC AND TECHNOLOGICAL PROGRESS**  
**№ 7(61) 2021**  
SCIENTIFIC AND PRACTICAL JOURNAL

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Manuscript approved for print 19.07.21  
Format 60.84/8  
Conventional printed sheets 3.95  
Published pages 1.89  
200 printed copies

16+

Printed by Zonari Leisure LTD. Paphos