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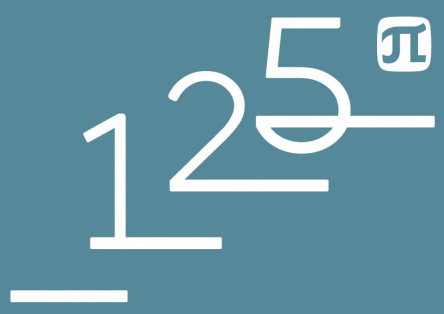

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OPTIMIZING THE PROCESS OF DEFINING AREAS OF RESPONSIBILITY IN THE CONTEXT OF SMALL AIRCRAFT LEASING USING EAM SYSTEMS

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Abstract. This study focuses on optimizing the process of defining responsibility zones within the context of leasing for small aviation using an Enterprise Asset Management (EAM) system. The management of responsibility zones is crucial in the leasing process of small aviation, and the application of EAM systems enhances efficiency. The paper examines the complexities involved in determining responsibility zones and proposes an innovative conceptual model that leverages EAM technology. The model facilitates the accurate allocation of responsibilities, streamlines leasing operations, and contributes to the overall efficiency of the small aviation leasing industry. The practical significance of this research lies in its potential to enhance the precision and effectiveness of responsibility zone determination, ultimately benefiting the management of small aviation leasing operations.

Keywords: small aviation, leasing operations, areas of responsibility, EAM systems, asset management

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ОПТИМИЗАЦИЯ ПРОЦЕССА ОПРЕДЕЛЕНИЯ ЗОН ОТВЕТСТВЕННОСТИ В КОНТЕКСТЕ ЛИЗИНГА МАЛОЙ АВИАЦИИ С ПОМОЩЬЮ EAM-СИСТЕМ

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Аннотация. Данное исследование посвящено исследованию оптимизации процесса определения зон ответственности в рамках лизинга для малой авиации с использованием системы управления активами предприятия (EAM). Управление зонами ответственности имеет решающее значение в процессе лизинга для малой авиации, и применение EAM-систем повышает его эффективность. Актуальность данного исследования заключается в возможности повысить точность и эффективность определения зон ответственности, что в конечном итоге благоприятно скажется на управлении лизинговыми операциями малой авиации. В статье рассматриваются сложности, связанные с определением зон ответственности, и предлагается инновационная концептуальная модель, использующая технологию EAM. Модель способствует точному распределению обязанностей, оптимизирует лизинговые операции и повышает общую эффективность лизинговой отрасли малой авиации.

Ключевые слова: малая авиация, лизинговые операции, зоны ответственности, EAM-системы, управление активами

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Introduction

In the modern world, the development of the aviation industry is becoming a key factor for ensuring global economic integration and socio-cultural development. An important component of this industry is small aviation, which has significant advantages in mobility and communication, providing transportation of passengers and cargo to remote regions with limited access. There is a great potential for the development of small aviation in Russia, which is the only means of transport accessibility in most parts of the country and in many regions is the dominant component of the transportation system. Nevertheless, there are only 3.1 small aircraft per 100 thousand people, which indicates a low level of development of this industry (Petrenko, 2016; Prosvirina, 2020; Sokolov, 2007). The results of the analysis of the state of civil aviation in Russia and the prospects for the development of air transportation emphasize the need to find technical and financial solutions to meet the needs of operators and aircraft manufacturers. Aircraft fleet renewal requires significant investments, and leasing is the most promising form of investment activity for civil aviation. Foreign statistics shows that more than half of aircraft in the world are acquired through leasing transactions.

The development of leasing operations in the Russian market began since the inclusion of the term "Leasing" in the Civil Code of the Russian Federation in 1995. The law "On Finan-

cial Lease (Leasing)" in the edition of 04.11.2014 N 164-FZ regulates this sphere, considering changes and additions since its adoption in October 1998 (Federal Law of October 29, 1998). This law provides a definition of the term "leasing" as a set of economic and legal relations arising under a leasing agreement, which includes the acquisition of the leasing object. The leasing agreement, in turn, is an agreement under which the lessor undertakes to purchase property from the seller and provide it to the lessee for temporary possession and use for a fee.

To date, the concept of "Aviation leasing" is widespread, which is a specific type of leasing, where the objects are aircraft together with the relevant infrastructure and equipment. The main principles of aviation leasing organization include urgency, payment, and cost-effectiveness. Based on these principles it is possible to formulate the essence of aviation leasing as a complex economic and legal relations between three main subjects: lessor, lessee, and seller (Kabirov, 2017; Efimov, 2010; Dun, 2012). Within the framework of such relations the investing leasing company acquires a certain aircraft or other aviation property from a particular manufacturer and provides this property for temporary possession and use to the lessee for regular leasing payments. At the same time, such a scheme provides an opportunity for commercial flights and provides for the transfer of ownership in the future.

Comparing aircraft leasing with other delivery schemes, the following advantages can be emphasized (Baeva and Ismagilova, 2023; Buryatin, 2019; Dobrovolsky, 2011):

1. A flexible payment scheme in which the bulk of the payments can be deferred to a later period. This is especially relevant for aircraft which, after a long period of use on route networks, begin to bring more significant profit;

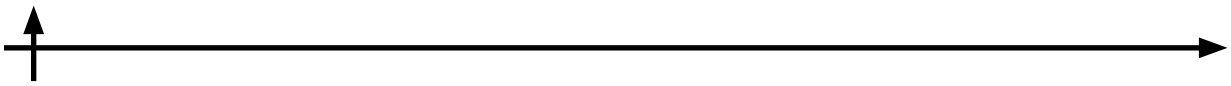
2. Absence of the aircraft on the airline's balance sheet, which excludes an increase in its assets and exempts it from paying property tax;

3. Exposure of aircraft, acting as objects of leasing, to accelerated depreciation.

To solve this problem, it is proposed to investigate the potential of applying advanced Enterprise Asset Management (EAM) technology in small aviation. EAM systems, with their high efficiency, can significantly contribute to improving the transparency, control, and coordination of asset management processes, including aircraft and related equipment. By systematically analyzing data on the condition, maintenance and operation of aircraft, EAM systems not only provide more accurate information on the current condition of assets and their technical readiness, but also have the potential to be a powerful tool for analyzing incidents, identifying root causes, and determining responsible parties.

Materials and Methods

Digital transformation and the introduction of the latest technologies have become an important factor in today's aviation industry, including small aviation. As part of the drive to optimize asset management processes and improve aircraft lifecycle efficiency, aviation companies are increasingly turning their attention to CALS (Continuous Acquisition and Lifecycle Support) technologies. CALS technology is a concept and methodology for product lifecycle management, including the phases of development, production, operation and maintenance (Sazonov et al., 2018). In small aviation CALS-technologies are of special importance, as they allow to optimize asset management, perform operational control over aircraft condition and improve coordination of work of all links of the production process. At the same time, CALS technologies provide a unified information environment for collecting, storing and analyzing data on aircraft operation and maintenance (Zaitsev, 2022). This integration of data from various life-cycle participants creates a single information resource available to all stakeholders. This provides transparency and accuracy of data, which can simplify the process of determining



responsibility when incidents or accidents occur.

One of the representatives of CALS-technologies in the field of asset management is EAM-systems. EAM focuses on the effective management of enterprise assets throughout their life cycle, including equipment, machinery, vehicles and other physical assets. It is a complex integrated software specifically designed for the management of physical assets of enterprises, allowing to automate maintenance and repair (MRO) processes, modernize the processes of repair and maintenance management of equipment to improve their efficiency, as well as integrating all participants of the life cycle within a single information field. EAM is a continuation and development of the Asset Management concept, which was introduced by international standards of ISO 55000 series (ISO 55000:2014). The system helps to increase the efficiency of processes, reduce the probability of downtime and maintain maximum availability of equipment, which ultimately reduces the cost of its operation and increases the profitability of the enterprise.

EAM provides a wide range of tools for equipment and infrastructure management, including (Antonenko, 2015; SMB-Test, nd.):

1. Inventory and spare parts management. EAM allows to optimize inventory and spare parts management, minimizing the costs of their storage and acquisition. The system helps determine optimal inventory levels based on equipment utilization and forecasting;

2. Technical Data Management. EAM allows you to store and manage all necessary information on equipment specifications, including operating instructions, technical drawings, schematics, etc.;

3. Preventive maintenance and repair management. With EAM you can create and plan preventive maintenance and repairs of equipment based on its technical condition, as well as monitor their fulfillment;

4. Monitoring and evaluation of equipment technical condition. EAM allows you to collect and analyze data on the condition of equipment, which allows you to determine the need for preventive maintenance and repair;

5. Application of technology of technical condition forecasting. On the basis of data analysis the system allows to plan maintenance of units and equipment in advance;

6. Spare parts and materials order management. With the help of EAM it is possible to create and track orders for spare parts and materials, as well as to control their fulfillment;

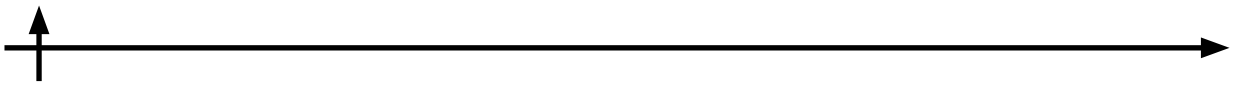
7. Documentation Management. EAM allows you to store and manage all necessary documentation related to equipment and infrastructure, including quality certificates, warranties, etc.;

8. Analytics and Reporting. EAM allows you to analyze data on equipment and infrastructure usage, evaluate their efficiency and identify areas for improvement. The system also provides extensive reporting and dashboarding capabilities;

9. Efficient management of assets and maintenance processes with a single hub for asset and equipment information.

Before analyzing the application of EAM technologies to the task of defining areas of responsibility, specialized software modules and system features that optimize multiple phases of the aircraft life cycle should be studied.

First, EAM provides a system for aircraft condition analytics and event forecasting that takes as input data from aircraft sensors based on IoT technologies, as well as business data containing information on operating modes and maintenance activities (Ivanov et al., 2018; Stepanova, 2014). Collecting and combining such a wide layer of data in a single information environment allows analysis in new and more detailed sections of information, realizing Condition Based



Maintenance (CBM) and Predictive Maintenance (PdM) strategies.

CBM, or Condition Based Maintenance, allows maintenance of equipment based on its actual condition and performs work only when there are certain signs of malfunction or wear of on-board equipment (Rodionov and Kalinina, 2014). In turn, PdM, or predictive maintenance method, uses data analysis to predict the need for maintenance or parts replacement before clear signs of failure occur. In this way, the operator can supplement traditional preventive maintenance and condition-based inspections with more accurate and effective strategies that can be used to inform Maintenance Programs and Plans.

EAM also includes an Asset Strategy and Performance Management solution that provides specialized tools that support all types of analysis in use - RCA, RCM, FMEA and PM Review (SAP, nd). The specialized tools in EAM are highly accurate and focused on specific tasks. For data analysis, the system provides quality and reliable information because data is collected and analyzed automatically. The high reliability of the tools is also due to the use of new aircraft condition analytics technology, which provides valuable information for further analysis of system reliability and finding the causes of failures. Moreover, the system allows for the integration of analytical results with other modules, which facilitates equipment management and reduces decision-making time. The software module also allows you to create effective reliability-oriented Maintenance Programs and Plans based on the analysis performed by the tools (Sharafeev and Ermolenko, 2013). This approach ensures continuous monitoring and continuous improvement of the Maintenance Program, allowing you to balance maintenance costs against risks. Thus, it is possible to achieve a more efficient use of resources and reduce the probability of breakdowns and costly repairs.

As part of the system, a joint asset management service has been implemented, providing the possibility of information exchange between the operator and the equipment manufacturer within a single network channel, which allows them to have access to a "single version of the truth", i.e., to a common database with information on assets. This simplifies the process of interaction and collaboration between the operator and manufacturer and ensures harmonized processes across a single business network. As a result, the operator and manufacturer can exchange information on asset condition, failures, spare parts and maintenance recommendations more quickly and accurately. This approach increases the efficiency of work, reduces the time for information retrieval and transfer, and improves the quality of aircraft repair and maintenance.

Integration of EAM-system with ERP allows planning of MRO, equipment, and repair crews to perform the planned work. All information flows are synchronized between the systems, which allows to improve the efficiency of aircraft repair and maintenance management, reduce downtime, increase aircraft availability, and optimize the level of resources and stocks in warehouses required for aircraft maintenance. A set of procedures implemented with the help of EAM allows to build a process in full compliance with the concept of integrated logistics support, allowing to improve the efficiency and optimization of MRO processes, as well as to increase the level of transparency and coordination of all stakeholders.

Results and Discussion

As mentioned earlier, EAM is a set of technologies that collect, store and analyze data from all participants in the aircraft lifecycle. These technologies are mainly used to optimize asset management and provide better control over maintenance and operations processes (Ilin et al., 2017; Kuzmenko, 2018). However, the potential of EAM can also be applied to analyze the determination of liability for incidents and accidents in small aviation. Focusing on the issue of liability, it is worth noting that the delineation of liability for various events and incidents between life-cycle participants is based on unique contractual provisions. These provisions are

developed by experts individually for each leasing company and there may be many variants of liability delimitation. Therefore, this paper will not focus on examples of specific delineations, as the primary and most difficult task is to establish the causes of incidents, after which identifying the responsible party is a relatively trivial task. Instead, the focus will be on analyzing the potential of applying EAM systems to situations that are of concern to leasing companies due to the difficulty of determining root causes and gathering evidence, namely, parts failures and airplane crashes.

Airplane crashes, in addition to the tragic consequences for people, also have huge financial implications. The loss of aircraft, passengers and cargo is accompanied by significant costs for compensation, investigations and possible lawsuits. Part failures also pose a significant threat to flight safety and efficiency (Makhotkin, 2008; Martirosyan and Pavlyuk, 2018). Despite rigorous technical inspections and maintenance, even the smallest defects can lead to serious consequences and costly repairs. Considering the above situations, it is necessary to highlight the main causes of their occurrence in order to further explore the possibilities of their identification based on the components of EAM systems.

Aircraft crashes occur due to diverse reasons, such as:

1) Technical Failures: One of the main factors causing airplane crashes is technical failures of aircraft or aircraft components. Malfunctions in engines, control systems, fuel systems, and other critical components can lead to loss of control of the airplane and crash;

2) Manufacturing Defects: Defects discovered during the manufacturing of aircraft or aircraft parts can lead to serious consequences during operation. Problems with materials, assembly, or quality can lead to unexpected failures;

3) Improper operation: Piloting errors and improper handling of aircraft is another common cause of airplane crashes. Incorrect maneuvers, improper takeoff and landing procedures, and failure to follow safety protocols can cause serious incidents;

4) Weather: Extreme weather conditions such as high winds, thunderstorms, icing, and poor visibility can severely impact flight safety. Uncontrolled changes in weather can cause piloting difficulties and lead to airplane crashes.

Parts failure:

1) Manufacturing defects: Defects that occur during the manufacturing of parts or equipment can be a source of unpredictable failures during operation. Poor quality materials or assembly can lead to serious consequences;

2) Wear and Aging: Constant use and operation of aircraft causes parts to wear and tear. Over time, defects and damage can occur that can cause breakdowns;

3) Failure to keep up with maintenance: Failure to perform regular maintenance and repairs can lead to degradation of parts and equipment. The need for replacement or repair can occur suddenly, increasing the risk of accidents;

4) Maintenance error: Improper maintenance and repair can also lead to parts failure. Improper installation or adjustment of parts can lead to defects and additional problems;

5) Exposure to external factors: Aircraft can be exposed to various external factors such as weather conditions, mechanical damage, and others. These factors can cause parts and equipment failure, even during normal operation.

In order to better understand the relationship between the incident that occurred and various factors, and to prevent similar incidents in the future, companies need to conduct detailed analysis using a variety of methods and available data (James and Lee, 2004). In this context, EAM systems have significant potential for structuring and analyzing aircraft information. The set of tools used in such systems allows for a deeper understanding and analysis of the events and possible causes that influenced the development of the incident (see table 1).

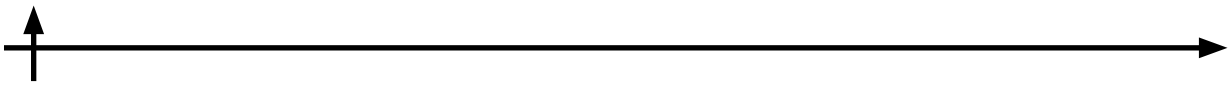
Table 1. The capabilities of EAM systems and their potential application for incident root cause analysis

Analysis tools	Application potential
Base of analytics of the state of AF components	An aircraft component condition analytics database can be consulted to analyze the incident that occurred. This database may contain historical data on the condition of parts and components, showing signs of degradation or anomalies that may have led to the incident. Using this data, it is possible to determine if there were any warning signals of a possible failure.
Collection of maintenance and operational data	Information on routine maintenance, parts replacement and operating conditions helps to understand what actions were taken prior to the incident and under what operating conditions. This data may indicate inadequate maintenance, missed inspections, failure to observe weather conditions or other factors that may have affected flight safety.
Collecting data from component manufacturers	In the event of an incident, access to parts data from component manufacturers can be quickly established. This data may include documentation, technical specifications, operating recommendations, and other details. Analysis of this data can identify possible scenarios related to component defects or events that may have contributed to the incident that occurred. Additionally, this analysis can lead to the identification of causal factors such as manufacturing defects or defects that may have been inherent in a particular batch of parts.
Information on RCM analysis results and developed Maintenance Programs	The results of the reliability analysis as well as the MRO program can be valuable in analyzing incidents that have occurred. By correlating the data from the RCM analysis with the actual incident events, it can be determined whether the risks and potential causes of failure have been addressed in the applicable Maintenance Program.
Digital twin	Using a digital twin of aircraft and components, a virtual simulation of an incident can be conducted. This will help to understand what parameters and scenarios could have led to the incident and what changes in conditions could have prevented it from occurring.

After identifying the main factors contributing to incidents and determining the available analysis tools within EAM systems, it is important to correlate them (see table 2 and table 3). In the case of leasing companies focused on the provision of aircraft for operation, this systematization may have important practical applications.

Table 2. A comparison of the causes of airplane crashes and potential root cause analysis tools

Possible causes	Analysis tools	Rationale for use of the tool
Technical faults	Aircraft component condition analytics database	Analyzing historical data on the condition of parts and assemblies can identify signs of degradation or anomalies that may have contributed to technical failures.
	Collection of maintenance and operational data	Information on maintenance performed and parts replaced may indicate failure to perform regular maintenance or insufficient attention to the condition of components, which may have led to technical faults.
	Data collection from component manufacturers	Analyzing parts data and specifications from manufacturers allows you to identify defects or inconsistencies that may have caused technical malfunctions.
	Information on RCM analysis results and developed Maintenance Programs	Analysis of unaccounted risks or inaccuracies in the design of the Maintenance Program may explain the cause of the technical failure of the equipment.
Manufacturing defects	Data collection from component manufacturers	Manufacturing performance and component inspection data can reveal the presence of defects made at the manufacturing stage.
	Base of analytics of the state of AF components	Analysis of historical data on the condition of parts and units allows to identify signs of early degradation of elements earlier than the manufacturer's stated period of time.



Possible causes	Analysis tools	Rationale for use of the tool
Improper use	Base of analytics of the state of AF components	Historical data on operating modes can help identify non-standard utilization scenarios that may have led to improper operation and airplane crashes.
	Collection of maintenance and operational data	Identification of discrepancies in the validity of data on maintenance performed and operating modes may signal the cause of an airplane crash.
Weather conditions	Base of analytics of the state of AF components	Data on component response to extreme weather conditions can help identify which components suffered degradation due to weather factors that may have led to the airplane crash.
	Collection of maintenance and operational data	Data on aircraft operating modes and conditions can help identify situations in which aircraft crashes have occurred due to operation in hazardous weather conditions.
	Digital twin	Virtual simulation of flight scenarios in different weather conditions allows us to determine which parameters could have influenced the occurrence of an airplane crash in extreme weather conditions.

Table 3. Comparison of causes of aircraft parts failures and potential root cause analysis tools

Possible causes	Analysis tools	Rationale for use of the tool
Manufacturing defects	Data collection from component manufacturers	Part documentation and performance data can reveal defects or inconsistencies that were inherent in the parts at the manufacturing stage and may have caused a defect.
	Base of analytics of the state of AF components	Analysis of historical data on the condition of parts and units allows to identify signs of early degradation of elements earlier than the manufacturer's declared period.
Wear and aging	Base of analytics of the state of AF components	Historical data on the condition of parts can reveal the extent of wear and degradation, which can be the cause of failures due to aging components.
	Collection of maintenance and operational data	Data on regular replacement and maintenance of parts can indicate the extent of wear and areas requiring special attention. Lack of replacements can lead to unacceptable wear and ageing, increasing the risk of failure.
Failure to comply with maintenance schedules	Collection of maintenance and operational data	Failure to meet maintenance schedules can lead to component degradation and increase the likelihood of failure. Analyzing maintenance and replacement data can help you determine if failure to meet maintenance schedules was the cause of failures.
Service error	Base of analytics of the state of AF components	Historical data on the condition of parts and assemblies can reveal inconsistencies and defects that may have occurred due to errors in previous maintenance or repairs.
	Collection of maintenance and operational data	Missing maintenance records or improperly performed maintenance can lead to defects and part failures. Analyzing maintenance records can reveal errors and inconsistencies that caused the failure.
Impact of external factors	Base of analytics of the state of AF components	Data on how parts react to external factors, such as mechanical damage or weather conditions, can reveal which components have been affected and may have caused failure.
	Digital twin	Virtual simulations of the effects of various external factors on components provide insight into what exposure scenarios may have caused parts and equipment failures.

The application of the presented methodology for analyzing incidents and aircraft breakdowns using EAM-systems tools opens up significant prospects for improving safety and reliability in the aviation industry. The integration of data on component status, maintenance, reliability analysis and other aspects into a single information space facilitates a deeper and more systematic analysis of the events that occurred. This approach not only identifies the spe-

cific causes of incidents, but also the context and interrelationships between the various factors.

Moreover, the use of this methodology can have a significant impact on determining the degree of responsibility for incidents and breakdowns. A systematic analysis based on objective data helps to better identify those responsible for the events that occurred, helping to prevent unfounded accusations and provide an objective evidence base.

Conclusion

This paper presented a methodology for analyzing aircraft incidents and breakdowns, taking into account the active use of EAM-systems tools. Analyzing the main causes of aircraft accidents and parts defects, an approach was developed focused on systematization and analysis of data received from various participants of the aircraft life cycle. The merging of this information into a single information platform enables systematic and in-depth analysis of the events that occurred. This new perspective of data utilization allows the identification of not only the surface causes, but also the root causes of incidents, contributing to a more complete understanding of the context and dynamics of events.

Of particular note is the ability of this methodology to have a significant impact on the process of identifying responsible parties for incidents and defects. A more accurate and objective analysis based on concrete data serves as a safeguard against unfounded accusations and provides an objective basis for identifying actual responsibility. These measures contribute to a more balanced and fair mechanism for determining the guilty parties.

Thus, the use of the proposed incident analysis methodology with the integration of EAM systems opens new horizons for improving the efficiency and confidence of leasing companies in small aviation. This approach facilitates more in-depth and detailed analysis of events, accurate determination of actual responsibility and, as a result, contributes to further improvement of the small aircraft operation system.

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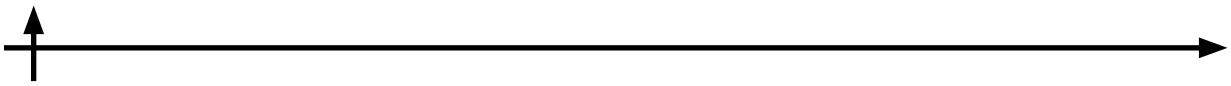

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IMPLEMENTATION OF COMPUTER VISION TECHNOLOGIES IN THE BUSINESS PROCESSES OF FMCG COMPANIES

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Abstract. The use of artificial intelligence and image recognition applications in merchandising can significantly improve the sales process and increase business efficiency. Such applications allow to quickly and accurately analyze data, determine customer needs and offer the most appropriate products. The relevance of this research is dictated by directly operating companies in the FMCG segment, as such applications can help to increase sales, quality of customer service and improve business efficiency in general. In the course of writing this article, we analyzed scientific research on the application and development of photo and video recognition systems, researched the market of applications with computer vision, considered the features and subtleties of their potential implementation. As a result, the prospects and risks of implementing IR applications in large international companies were assessed.

Keywords: merchandizing, computer vision, image recognition, apps, FMCG companies

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ВНЕДРЕНИЕ ТЕХНОЛОГИИ КОМПЬЮТЕРНОГО ЗРЕНИЯ В БИЗНЕС-ПРОЦЕССЫ FMCG КОМПАНИЙ

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Аннотация. Использование приложений с искусственным интеллектом и распознаванием изображений в мерчендайзинге может значительно улучшить процесс продаж и повысить эффективность бизнеса. Такие приложения позволяют быстро и точно анализировать данные, определять потребности клиентов и предлагать наиболее подходящие товары. Актуальность данного исследования диктуется непосредственно действующими компаниями FMCG сегмента, поскольку такие приложения могут помочь увеличить продажи, качество обслуживания клиентов и повысить эффективность бизнеса в целом. В ходе написания данной статьи, был осуществлен анализ научных исследований на тему применения и развития систем распознавания фото и видео материалов, исследован рынок приложений с компьютерным зрением, рассмотрены особенности и тонкости их потенциального внедрения. В результате, была проведена оценка перспектив и риска внедрения IR приложений в крупные международные компании.

Ключевые слова: мерчендайзинг, компьютерное зрение, распознавание фотографий, приложения, FMCG-компании

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Introduction

In today's increasingly competitive business world, companies and entrepreneurs are looking for new ways to improve their sales and make their businesses more efficient. One such way is the use of artificial intelligence and image recognition applications in merchandising. The use of artificial intelligence and image recognition applications in merchandising can significantly improve the sales process. Such applications are used to analyze sales data, customer behavior, and customer preferences (Kellermayr-Scheucher, 2022; Levina and Galanova, 2022). They allow you to quickly and accurately determine which products are most popular with customers, which products are in high demand, and which are not. In addition, artificial intelligence and image recognition applications can help determine which products should be placed on the shelves to attract customers' attention. They can suggest the most effective ways to organize displays that will attract customers and increase sales. This is especially important for stores with a large assortment of products, where organizing space is a challenge. Artificial intelligence and image recognition applications can also help suggest the most appropriate products to customers. They can analyze customer shopping data and suggest items that are most likely to appeal to them. This can improve customer satisfaction and increase the likelihood of repeat purchases. These apps can help improve the inventory process. They can quickly and accurately

determine which items are in stock and which items need to be ordered. This can help avoid situations where there are not enough items on the shelves, or where items remain unsold due to lack of demand.

Automatic shelf recognition systems are now in their second generation. Technology and engineering has made fantastic leaps forward in the last three years. Recognition accuracy has reached 96-98% for most operators. The time and cost of photo processing has fallen to a level that is acceptable to most customers. As a result, image recognition systems have become the focus of merchandising and retail auditing.

In a few years, fast and flexible learning neural networks have become a technology available to most developers. Now almost all IT professionals can master neural networks. As a result, many solutions have appeared on the market, including those based on "computer vision". Some of them turned out to be in great demand in the retail industry. Neural networks have made it possible to analyze store shelves for the presence or absence of certain products.

Computer Vision (CV) is a field of artificial intelligence that knows how to analyze incoming images and videos. It contains methods that endow a computer with the ability to "see" the necessary data in a picture and then process it (Bikash, 2019; Computer vision, nd.).

The innovative solution consists of a camera (photo or video) and software. Depending on the task, the software can analyze different objects. Teaching a computer to "see" is not easy. You have to "show" it a lot of photos so that it can identify the raw data. The photos should contain different combinations, features, objects. Today the development of CV-systems is far from realizing all its possibilities. The industry is rapidly developing and the range of computer vision applications is constantly expanding. Some people can unfairly fulfill their professional obligations, and merchandisers, like any other employees, need to be monitored. Therefore, developers are trying to solve this problem these days. About 50% of the learning process starts with the material - labeled pictures of items that need to be identified. With their help, we train the neural network to "understand" what is depicted in the image. The goal of this step is to create a system that recognizes the exact model (in our case, the article) of a product from a picture taken on a cell phone or tablet.

Another important step is to continuously train the neural network. Whenever an SKU has new features (e.g. package design, size, label changes).etc.), the neural network is trained to utilize the new features. Let's take a closer look at common approaches and their challenges. The task of recognizing goods on shelves poses several important mathematical problems (Giusti, 2017; Shelf recognition systems, nd.):

– products may be located close to each other;
– products may overlap;
– a catalog of products may contain tens of thousands of items;
– products are constantly being added and removed. New flavors, seasonal offerings, etc.;
– classes are likely to be unbalanced. When collecting data sets, there may be classes with tens of thousands of examples and classes with units of examples;
– shooting takes place in difficult conditions: limited lighting, difficult angles.

There are programs with an additional module "Image Classifier", which automatically recognizes the class (type) of a photo and checks whether it is allowed to use this class of photos in reports of a certain type. The module provides comprehensive analytics for the administrator on the website and for the supervisor in the app. This technology can be very useful for FMCG companies.

Basically image recognition technology can check shelf availability, analyze the shelf share in facing in relation to their competitors and monitor the compliance of display standards (Lijuan, 2022). But in addition, advanced image recognition can also help in finding inactive products

on the shelves. An employee will be able to check whether all products on the shelf are officially manufactured at the moment and identify illegal trade. It is possible to update current matrices (i.e., monitor compliance and changes). Unlike merchandisers, image recognition technology extends to all goods, including those outside the matrix.

Additionally, the shelf share and availability on that shelf can be calculated. Thus, image recognition makes the work of not only merchandisers but also KAMs transparent. One may wonder: how to understand that the recognition is working correctly? Nowadays, neural networks are advanced enough to successfully recognize and classify objects in photos. But some factors can reduce the likelihood of success. There may be too few items on the shelves, there may not be enough light, or there may simply be an error and the item is not recognized (or recognized incorrectly). Here's a solution that a number of companies offer. If a merchandiser notices in the process that some objects are not recognized correctly, he can make a request. A specialist in the application will check it and correct all the flaws manually. Usually such a company has its own team of auditors, which constantly works on verifying the results of automatic recognition and allows you to guarantee quality recognition of objects. Modern technologies become cheaper over time.

Materials and Methods

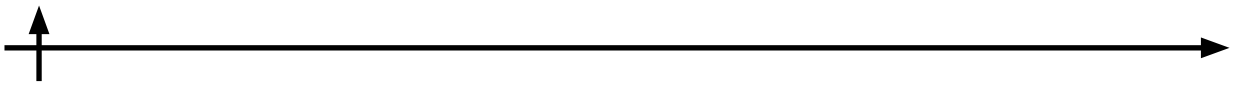
In the course of the study, an in-depth analysis of existing applications with the recognition function and the experience of their application to date was carried out. The works of leading researchers in the field of using innovative technologies to improve the economic efficiency of FMCG enterprises were reviewed. The research applied general scientific methods such as analysis and synthesis, comparison, and classification for a more fundamental consideration of image recognition models and data processing and transmission schemes.

Results and Discussion

Software vendors claim that time costs are reduced by 40-60% on average. But there are more impressive examples of time savings: up to 80% in a single visit. The speed of processing incoming data increases by almost two orders of magnitude. Most systems process visual data in near real time. A report from the software on compliance with the planogram, calculation of the radius fraction and the number of fasteners is received within 20-30 seconds. The probability of error is minimal. The accuracy of beam recognition systems currently ranges from 92% to 98%. Although there are some "problem" product categories that "mess up the statistics", several problems can be solved at the same time. Several problems can be solved at the same time. A shelf recognition system allows you to control prices and track promotions (availability of promotional materials, special price tags, design of additional outlets, etc.). Routine tasks take less time and staff can be directed to other tasks.

Recognition vendors attract customers by promising fast implementation (one to two months), easy transition from testing to full implementation and easy integration with the customer's CRM system. Automatic recognition solutions can be used for automatic visit quality control (Wang, 2018). This is not yet the most popular option among clients, but probably the most active IR users will soon utilize this functionality. The accumulation of data with visit evaluation allows comparing the effectiveness of individual merchandisers, the long-term dynamics of the quality of their work and the effect of incentive programs. Successes between networks and territories can be compared. In general, a marketer has a lot of opportunities.

All of the above is true when working with a well-trained neural network. Therefore, any supplier of such solutions will first offer the client to conduct preparatory work, to set up the network to work with a particular product, in a particular package and in a particular store.



The quality of the materials supplied will determine the success of the entire project. Many developers say that it is better for them to train the system in the field rather than in a "lab" environment. This is a very important point because neural networks "get smarter" as more and more information is downloaded.

Existing experience in the field of recognition applications indicates that there are problems that may arise in the recognition process for various reasons. The main set of problems is summarized as follows:

1. If the photos uploaded to the system were taken under normal lighting conditions and later the store decides to illuminate the shelf with neon lights, the recognition can be significantly impaired;

2. Sometimes it happens that the merchandiser may not be able to take a picture of the entire shelf at once. He has to take several pictures and "assemble" them in the application. This is good if the vendor's software has this "stitching" feature and it works well. Otherwise, distortions and analysis errors may occur;

3. The angle at which the photo was taken can also affect the quality of recognition. It is therefore worth organizing a small workshop among merchandisers on how and what to photograph once the project has started. Vendors almost always provide buyers with tutorials on how to take photos;

4. If the product being photographed is behind glass, glare and reflections can prevent good recognition;

5. Irregularly shaped shelves or product placement can also cause problems.

Interaction with external developers and integration is usually carried out through the customer's IT department, whose employees can set up data offloading from existing systems and, if necessary, coordinate communication and establish cross-team work with any third-party developers. Let's take a closer look at the SaaS service. It can be integrated into any existing business process with minimal integration. The customer continues to use the existing mobile app, but adds new features for product recognition, analysis of key performance indicators related to checkout, and analysis of product reorders. Systems with universal data exchange gateways are preferred by the customer and provide greater flexibility. Lego manufacturer principle. Russia is finalizing the development of a gateway that will allow the SFA system to work with most IR systems. OPTIMUM SkyNet Retail system is fundamentally different from analogues in that the entire recognition cycle takes place on smartphones and tablets and does not require the Internet. In addition, the recognition speed is only one or two seconds (Image Recognition for Retail, nd.; GOSNIIAS, nd.). To date, this is the only image recognition system in Russia that works directly on a smartphone or tablet without an Internet connection. Russian and foreign analogs are software that is installed on a mobile device and exchanges data with servers or the cloud using the network.

Working with data in computer vision applications has its own peculiarities that should be taken into account when developing and using such applications (Face Feature Test, nd.; FaceSDK Video Analysis Technologies, nd.; ResNeXt, nd.). The first peculiarity is that the data obtained by computer vision can be very diverse. It can be photos, videos, scanned images, etc. At the same time, the data can have different quality, resolution, color gamut and other characteristics. The second peculiarity of working with data in computer vision applications is connected with the fact that for data processing it is necessary to use special algorithms and methods of image analysis. These methods can be very diverse and depend on the specific problem to be solved. The third feature of working with data in computer vision applications is that it is necessary to use powerful computing resources for efficient data processing. This is due to the fact that image processing algorithms require a large number of calculations that cannot be

performed on a conventional computer.

Let's take a closer look at how SFA applications for merchandisers work. When working with big data, heterogeneous data is often collected from different sources. In order to work with this data, it needs to be combined. You can't just load them into one database - different sources may provide data in different formats and with different parameters. This is where data blending and integration - the process of combining heterogeneous information into a single format - comes in handy. To utilize data from different sources, the following methods are used (Leading European Online Conference on SaaS Investments, nd.; Yandex Vision, nd.; 3DiVi Face SDK, nd.):

1. Converting data into a common format: recognizing text from photos, converting documents, converting text to numbers;

2. Data Augmentation. If there are two sources of data about the same object, information from the first source is augmented with data from the second source to get a more complete picture;

3. Eliminating redundant data: if a source collects redundant information that is not available for analysis, it is removed. Data blending and integration is necessary when there are several different data sources and you need to analyze the data as a whole.

To get a complete picture of sales and demand, we need to collect various data: shelf space, product quantity, product name, product photo, planogram matrix. All this information comes from different places and usually in different formats. In order to work with them, you need to bring them together. Traditional data integration methods are mainly based on the ETL process: extract, transform and load. Data is extracted from sources, cleaned and loaded into a repository. The specialized tools of the Big Data ecosystem also have their own approach to data extraction, transformation and loading. Once integrated, big data undergoes further processing: analysis, etc. The system looks like this: data is extracted, cleaned and processed, placed in the company's data warehouse, and then exported for analysis. Figure 1 illustrates this scheme.

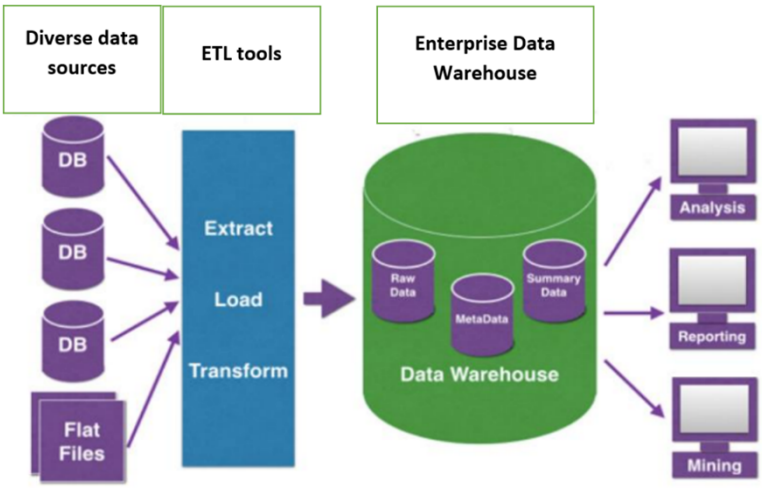


Fig. 1. Big Data processing

After training and testing, it can be used to process large amounts of data. Figure 2 shows how a simple neural network looks like: information is input to the input layer, processed inside and the result is output through the output layer.

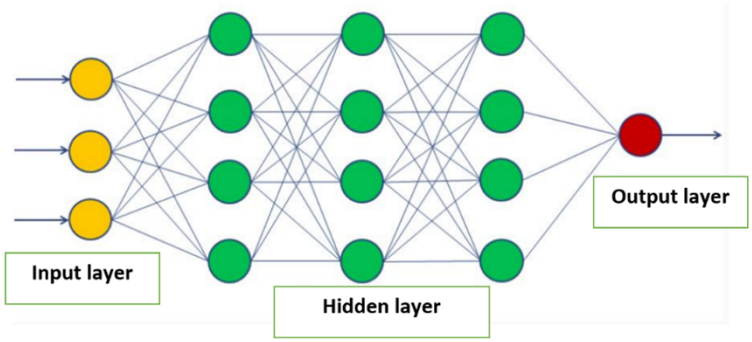


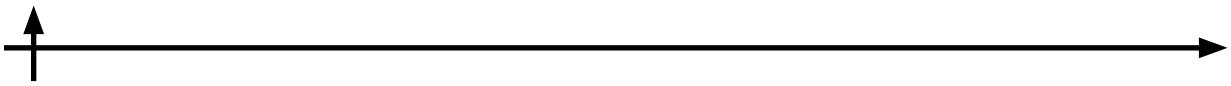
Fig. 2. Simple neural network

In order to solve the set tasks and achieve the main goal of the study, two programs available on the market were chosen: Let's consider them in detail by analyzing them. The first available program is EasyMerch - a business automation system for companies mainly in FMCG, but also in other areas (telecommunications, household appliances, pump and water filtration systems, medical products, stationery, etc.). EasyMerch is a unique tool for work: field employees (merchandisers, sales representatives, sales consultants, auditors, etc.) are provided with a full-fledged tool for daily work, and management staff - a reliable way of control. EasyMerch system structure. Mobile application for field employees - filling in reports, confirming with photos, recording geolocation and time of work at the point of sale. The app is available for iOS and Android devices and includes the following.

On-shelf product recognition - online recognition of products on the shelves by photos in the application (it is also possible to recognize products only on the web-interface after sending reports) to automate reporting on availability and shelf share, price monitoring, product location on the golden shelf, control of work performance by field employees. With online recognition, automatic addition of items in stock, filling in facings is available. Recognition for drawings, promotional images, printed materials, marketing materials, leaflets, brochures, catalogs, etc. is connected separately by individual CP. Orders - functionality of creating an order of goods through the mobile application. Support by a personal manager - database administration, individual technical support by a personal manager. Customization - individual development of additional functionality to EasyMerch according to technical specifications. Let's briefly consider the terms and conditions.

EasyMerch is developed by PRONETCOM LLC and is supplied only to legal entities under a non-exclusive license. Two weeks of demo-testing, which includes assistance in data loading, training, maintenance (Easy Merch, nd.). Monthly postpayment on the number of licenses used per calendar month. Data storage, technical support are included in the price. The second available system is iSellMore - flexible software for business process automation for trading companies of all shapes and sizes. Allows real-time tracking of field crews, sales representatives, merchandisers, couriers and managers. Provides a variety of analysis and planning tools for office staff and management.

The system aims to improve sales efficiency, productivity and agent discipline. Performance monitoring and automatic scheduling are available. The system is capable of forming an optimal scheme of covering the counterparty base and managing the personnel involved (Machine IntelligenceCity Brain Lab, nd.; NVIDIA DeepStream SDK, nd.). The automation system simplifies the work of field agents and office staff. The mobile platform allows to form any workflow with necessary restrictions and control for each agent. As the work is performed, the agent immediately sees the results of the current work, history and information about the completeness and



accuracy of the data entered. A web portal containing all necessary data is available to the office staff. This includes agent performance reports, scheduling and management tools, customer, employee and territory database configuration.

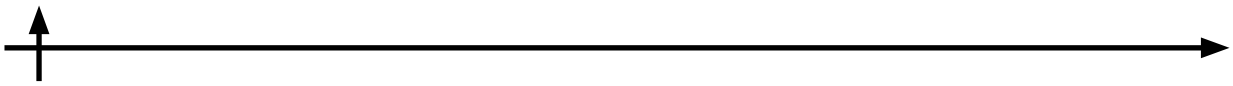
Key capabilities include the following:

- work with orders, balances, returns;
- detailed customer information;
- control of order history, shipments, sales, residuals, returns;
- stock balances;
- GPS tracking;
- job start and end control;
- limits;
- receivables;
- workflow planning;
- questionnaires, surveys;
- checkout control;
- price monitoring;
- presentations;
- photo reports;
- territory management;
- flexible mobile HTML reports for agents;
- integration with any accounting system;
- a wide range of operational reporting.

Assistance is provided to clients at all stages of implementation and operation of the application. It is possible to refine and fine-tune the system to meet special customer requirements. Data security from unauthorized access is guaranteed. Instant response of technical support on hotlines. The system is focused on FMCG companies' products (large number of SKUs, assortment matrices, returns, physical exchange, sales history, merchandising). The application and functionality is adaptable and customizable for the client. All functionality does not contain superfluous and is simple and clear (ABBYY FineReader Engine, nd.; Azure Cognitive Services, nd.). Technical support will solve all incoming calls, check the availability of orders with the client, consult on all issues, customize devices 7 days a week.

The development team has many years of experience in the FMCG sector. The management has substantial experience as analysts/managers in sales support departments of large FMCG companies. Has a good understanding of the changing needs of FMCG companies and are willing to tweak the system to fulfill them. There is an understanding of the working of key KPI's of FMCG companies. The company also offers to provide expert assistance in building analytical system, reporting, data collection campaigns etc.

The system allows you to build your own unique business process with its own terminology and logic like a constructor. Business processes can be arbitrary and tied to various parameters of a retail outlet/route characteristics, etc. As an example and templates of the process can be used such functions: placing orders, returns of goods; removal of balances in the point of sale; work with accounts receivable; price monitoring; audit in the point of sale (availability of goods and reasons for absence) - osa (on shelf availability), oos; fix GPS coordinates in the point of sale; take photos; participate in surveys that are created in the office; receive messages from the central office. The system allows to flexibly customize assortments in retail outlets and allows the agent to work both with a rigid visit plan and with his territory as a whole, deciding which outlets to visit and which not to visit. It is possible to download data when there is no internet or GPS access. The system stores planograms and other information about the agent's work. It



also allows you to enter and correct information about the client. There is a one-time license and payment is made for each photo taken, which is very profitable for the client.

Having analyzed these programs, the choice was made in favor of iSellMore as the most suitable tool for solving problems of FMCG companies. The system has the necessary technical properties and intuitive interface. In terms of payment, it is also a more advantageous option. A brief comparison of the systems is also presented in Table 1.

Table 1. Comparison of EasyMerch and iSellMore systems

EasyMerch	iSellMore
database maintenance: sales points and visit plans, routes and individual entities, availability matrices, planograms, promotions	database maintenance: sales points and visit plans, routes and individual entities, availability matrices, planograms, promotions
–	integration unit for communication with any external systems via API (1C, SAP, Magnit, Axapta, etc.) + supplementary modules
a variety of analytical reports with the possibility of scheduled uploading	a variety of analytical reports with the possibility of scheduled uploading
shelf recognition	shelf recognition, self-training of employees and coaching of subordinates, document management, orders
monthly subscription + 2 rub./photo	yearly subscription + 1.5 rub./photo
available for iOS and Android	available for iOS and Android

Conclusion

Sales force automation software, or SFA, is a solution that helps field teams do their jobs more efficiently. It's called Sales Force Automation software because sales departments were the first and are still the biggest users of this type of software, but there are other types of teams such as visual merchandisers, BTL marketers, service and support departments and many others that also use software with similar functionality. The first generation of SFA used specialized devices for field sales teams and needed to be connected to a computer at the end of the day to synchronize data. The latest solutions, however, use mobile apps for field teams and synchronize data with servers in real time using GPRS/3G/4G connections. A combination of mobile and web interfaces are used for backend and report viewing. Therefore, this study is driven by business needs.

In summary, we can say that shelf recognition technology can revolutionize merchandising. Checkout staff monitoring is becoming easier and more efficient, data and records from stores are coming online, and error rates are very much reduced. The most important thing is to keep in mind the limitations of the technology and the responsibility that each customer and supplier has to collect and provide quality input data, as well as analyze, transfer and secure the data. It can be said that in the case of IR, it is likely that the success of the project is entirely in the hands of FMCG companies. It is important for the company to understand the principles of photo recognition applications. It is necessary to control the implementation process and help the company creating the application to achieve the best results.

Without numerous tests and preparation for quality recognition, it will be very difficult to get a working system. It is also necessary to calculate the efficiency of the implemented solution and potential savings at the start of the project. After all, it may turn out that for a particular company this method will be just a way to keep up with the times, rather than improving the financial performance of the company. Working with the wrong app can increase the time a

merchandiser is on a retailer's site. It's safe to say that computer vision will be a very profitable solution for companies if approached with intelligence and careful preparation.

It is possible to significantly reduce the number of hired merchandisers or transfer employees to a new position, in case of production need in the company and the feasibility of implementing exactly this kind of applications. After thoroughly scanning the image, the program saves the collected raw data and allows users to create reports with shelf analysis. A possible outcome is to empower company agents with product image recognition. For example, management can conduct store analysis at least twice as fast as before. The selected iSellMore application is a rapidly evolving SFA (Sales-Force-Automation) solution that enables customers to improve field efficiency through better routing, tasking and execution management. iSellMore is a stable IT company that has been creating software solutions for FMCG business for over 10 years. The key advantage is development of a flexible software system for automation of business processes for field-force FMCG (sales representatives, merchandisers, supervisors, etc.). The system is fully customizable to the needs of the customer company. It is a convenient tool for analyzing, planning, creating tasks and control for both line managers and top management.

Further research should pay more attention to possible disadvantages of this kind of programs. Most likely there is a possibility of cheating and bypassing the system directly by merchandisers during work - it is necessary to control the conscientious performance of employees. Nevertheless, the use of applications with artificial intelligence and image recognition in merchandising can significantly improve the sales process and increase business efficiency. Such applications can quickly and accurately analyze data, identify customer needs, and suggest the most appropriate products. Companies that will actively develop the use of such technologies will be able to gain an advantage over competitors and strengthen their position in the market.

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FROM LIKE TO SALES: TO THE QUESTION OF AUTOMATION OF LEAD GENERATION PROCESSES IN SOCIAL NETWORKS AND LEAD QUALITY ASSESSMENT

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Abstract. The paper describes the process of lead generation in social networks and identifies the main methods of this process. The connection of lead generation with the work of a lead manager or other specialist performing his functions is shown, and a method for reducing the employee's time costs by automating the lead generation process is proposed, as well as a model for the formation of an integral indicator for evaluating the quality of leads. The research tasks were solved using the simulation modeling method in the AnyLogic program. The economic efficiency of the proposed methodology and its positive impact on improving the quality of marketing are substantiated. The results of the study can be used to create advanced models of the process of automation of lead generation and setting tasks for IT specialists, in the development of software products.

Keywords: conversion, lead, lead generation, social networks, simulation modeling, lead scoring

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ОТ ЛАЙКА ДО ПРОДАЖИ: К ВОПРОСУ ОБ АВТОМАТИЗАЦИИ ПРОЦЕССОВ ЛИДОГЕНЕРАЦИИ В СОЦИАЛЬНЫХ СЕТЯХ И ОЦЕНКИ КАЧЕСТВА ЛИДОВ

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Аннотация. В данном исследовании описан процесс лидогенерации в социальных сетях и обозначены основные способы генерации лидов. Показана связь лидогенерации с работой лид-менеджера или другого специалиста, исполняющего его функции и предложена методика сокращения временных затрат работника путем автоматизации процесса лидогенерации, а также предложена модель формирования интегрального показателя оценки качества лидов. В модели учтены факторы, ранее не использовавшиеся в подобных моделях, что представляет научную новизну. Задачи исследования были решены с помощью метода имитационного моделирования в программе AnyLogic. Обоснована экономическая эффективность предложенной методики и ее положительное влияние на повышение качества маркетинга. Результаты исследования могут быть использованы при создании расширенных моделей процесса автоматизации лидогенерации и постановке задач перед it-специалистами, при разработке программных продуктов.

Ключевые слова: конверсия, лид, лидогенерация, социальные сети, имитационное моделирование, лид-скоринг

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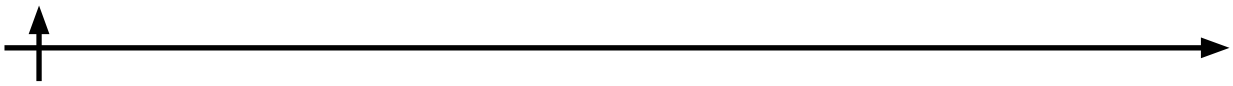
Introduction

Despite the large number of methods of lead generation and advertising, the process of evaluating the quality of leads, as well as the quality of sources of lead generation, remains largely at an intuitive level and is evaluated only at the last stage of evaluating the overall effectiveness of advertising investments. When even large companies have only a general idea about the assessment of the quality of leads and, as a rule, do not evaluate the dynamics of changes in leads and the quality structure of the sources of lead generation, then small companies may not have an idea at all about the possibility of lead generation from various sources.

In the article about sources of lead generation in Russia, the national researcher D.Yu . Savinovskikh asserts that the majority of Russian companies located outside of Moscow and St. Petersburg have a distant idea of the possibilities of lead generation (Savinovskikh, 2017). Meanwhile, companies in the world are spending more and more on lead generation services. Statistics show that the world's companies are increasingly interested in increasing the loyalty of their clients and the growth of the costs of working with advertising companies that rely on lead generation.



Materials and Methods

The purpose of this study was to create a model for automating the process of assessing the quality of leads (potential customers who have shown interest in a product or service) and automating the activities of smm-managers (lead managers or other specialists performing the functions of working with leads).

The methodological basis of the study was the method of computer simulation of complex systems, implemented in the AnyLogic software product. The program was created as a result of interest in constructing a mathematically interpreted description of the interaction of parallel processes in the early 1990s by a group of scientists from the St. Petersburg Polytechnic University and since then has seriously increased its capabilities in studying and modeling complex processes (Wikipedia, nd.). The presentation of the theoretical foundations and analysis of trends in the lead generation market was made on the basis of the work of Russian researchers (Nazarova, nd.; Andreeva, 2015; Volkov and Melekhova, 2012; Savinovskikh, 2017). The methodology for calculating marketing metrics was used according to the work of the Russian scientist Baranov (Baranov, 2017). Features of lead generation in marketing were described by the work of business analyst Laura Ramos (Ramos, nd.). The current problems and nuances of lead generation in social networks were studied on the basis of materials from marketing agencies (Web.com Academy, nd.a).

Results and Discussion

Nowadays, there is no solution on the Russian software market that allows the complex automation of the funeral and ritual sphere processes. Citizens who are faced with the decease of relatives and someone else are forced to go through several organizations in order to get the necessary documents for organizing the burial, and then search the most suitable funeral organization based on budget and services. The activities of funeral and ritual organizations are also poorly automated, interaction with applicants and clients is carried out through communication with ritual agents.

The object of the study was lead generation; the subject was the process of automating lead generation in social networks. In the course of the study, problem areas were identified in the approach to lead generation automation, namely, the discrepancy between implicit and explicit lead generation methods, which it was decided to combine in the process of lead generation automation. To solve the problem, it was proposed to create an integral indicator of the quality of leads. The result of the study was the construction of two simulation models: a model for creating an integral indicator of the quality of leads and a model for automating the work of a lead manager, which directly affects lead generation. The economic efficiency of the proposed measures was also substantiated.

1. Theoretical foundations of the lead generation process

To determine the process of lead generation, we will use the definition given by the Russian researcher AS Melikhova : "this is the process of obtaining contact information of a consumer who is interested or potentially interested in a product or service offered by a company" (Melekhova, 2013). Note that the consumer does not necessarily leave his information himself, it is enough for him to leave a like, repost, when it comes to social networks.

Lead manager - should be engaged in both lead generation and client management from the first targeted action on the site or in a social network to purchase (Goodleads, nd.). He is also responsible for evaluating leads for distribution to managers, depending on the client's readiness to buy. In practice, these functions are distributed among various employees: from the marketing director to the content manager. It is also possible to automate these processes in the CRM system. There are small companies in which sales are carried out exclusively on social networks.

In such companies, all of the above functions are performed by the smm manager.

It is believed that the following types of companies are primarily interested in high-quality work with leads:

1. firms in which a long cycle is built from interest to purchase is especially long. So, in construction organizations, it starts, as a rule, from several months;

2. firms that use large client bases, where direct communication with the client is maximally standardized or difficult;

3. firms whose product is "complex" and its purchase is not obvious to the buyer.

The process of lead generation and lead conversion can be broken down into five main tasks:

1. Lead generation - creating a lead base through various types of advertising or promotion.

2. Lead registration - entering lead data into the system for further work.

3. Lead assessment - ranking potential customers according to their readiness to purchase.

4. Lead development - a set of measures to "warm up" the lead, that is, push the client to buy before closing the deal.

5. Lead conversion - making a deal and completing the work with the lead.

The objectives of this article include the study of the lead evaluation stage. Our assumption is that lead scoring algorithms need more scientific elaboration and significant improvement through automation. Lead evaluation often occurs on an intuitive level, and the existing lead ranking algorithms are very primitive. this stage of work with a lead falls entirely on the shoulder of a specialist working with leads. Thus, this process is directly related to its activities and is interdependent with them.

2. Trends in the lead generation market and the main methods of the process

Indeed, many large companies are thinking about automating the lead scoring process. According to Laura Ramos, an expert at the international analytical agency Forrester Research, who analyzes the B2B segment of the business, many marketers focus not on the quality, but on the number of leads, thereby reducing sales efficiency, increasing the expenditure side of budgets and creating a gap between sales and marketing. In her opinion, marketers need technologies that will allow them to evaluate, verify, rank and grow leads (Ramos, nd.; Markov, 2023).

This issue is directly related to creating quality metrics and implementing them into lead management software. We list the useful functions that can be implemented by evaluating leads to the work of a lead manager or an employee performing his functions:

1. Identification of individuals and organizations

2. Qualification of leads according to the degree of readiness to buy (usually these are: cold, warm and hot lilas).

3. Ranging leads to customers who need additional information or discounts.

4. Saving time for an Internet marketer or other specialist working with leads.

Ultimately, these actions lead to an increase in the overall effectiveness of marketing, an increase in the speed of transactions and the competent management of ROI - a coefficient illustrating the level of profitability or loss of a company, taking into account the number of investments made .

According to the marketing agency MWI, an increase in the quality of leads by only 10% is then expressed in a 40% increase in sales (What is a lead, nd.). Moreover, these indicators are achieved by working only with the so-called “warm” leads, that is, those with an average level of readiness for a deal. The main technique here is assigning evaluation points to clients and calculating the indicator of the reasonableness of working with leads. The percentage probability of the possibility of concluding an agreement is compared.

From the point of view of the impact on the overall effectiveness of marketing, the following

positive factors in the lead evaluation process can be noted:

1. Improving the relationship of structures involved in promotions and direct sales. This is achieved due to the fact that sellers have the opportunity to significantly save their labor costs and work only with leads that have a high potential to close a deal.

2. A more complete picture of the typical buyer is formed, his expectations and the ability to offer the right goods or services in a timely manner.

3. An algorithm for maintaining a client is being formed. What is important is that the functions of marketers do not overlap with the work of sales managers.

Let's move on to the description of the functional features of lead generation. There are two main types of lead evaluation: explicit (direct, built on quantitatively measurable methods and evaluation algorithms) and implicit (qualitative, built on a voluntaristic definition by a marketer or difficult to formalize criteria for evaluation).

Explicit lead evaluation is based on data that is either provided by the client himself or obtained by working with him on the Internet. Such data can be ranked in order of importance and have a clear quantitative measurement, and, importantly, can be verified in one way or another.

This assessment method includes methods such as: BANT technology, demographic data provided by the buyer himself, according to his desire, and many others.

Let's give specific examples.

BANT - technology involves obtaining data from the buyer himself in 4 main categories: Budget - budget, Authority - authority, Need - needs and Timeline - terms (Marketing juice, nd.). Accordingly, it is necessary to understand whether the client has sufficient budget to complete the transaction, whether he has the authority to make this decision, whether the product meets his needs and what is the time range for making a purchase decision.

Implicit lead evaluation is based on data obtained implicitly, focused on the analysis of the client's behavior and its characteristics. Such data includes behavioral factors and reactions on the Internet, demographic data that is obtained without the participation of the client. For example, an analysis of a person's behavior on the Internet can be determined by what kind of materials he is interested in, what he views more often. And his location data can be used without his consent, by tracking IP.

Table 1. Methods estimates leads

A source of information	Implicit	Explicit
Behavior	Internet reactions	BANT-complex, consisting of budget, authority, needs and deadlines
Demographic data	Obtained without the participation of the client, with the probability of unreliability	Obtained with the consent of the client, with a greater degree of reliability

In modern lead generation, as a rule, these methods are distinguished and focus on either explicit methods or explicit methods. In the future, when constructing our model, we will try to take this circumstance into account. It should also be noted that the idea to combine implicit and explicit factors when ranking and evaluating leads in social networks does not belong to us, but was gleaned from the report of one of the world market leaders in creating marketing software, Marketo . Its closest competitors include IT industry giants such as Oracle and SAP. According to the latest information, TADVISER company was recently acquired by Adope (Tadviser, nd.). In the new software products of the company, intended mainly for B 2 B business, the idea of combining these factors is implemented (Lpgenerator, nd.). The program itself

ranks leads based on the gemographic data obtained as a result of content analysis, and then performs a new ranking based on the data received from the clients themselves or entered by managers as a result of communication with the client. The company's website states that the use of its products increases the effectiveness of marketing by 30%.

However, at the moment, other business segments and, especially, social networks do not have such software tools.

3. Features of lead generation in social networks

For the purposes of this article, we have limited our research to lead generation in social networks. The benefits of promoting through social networks include the following factors:

1. direct cooperation with potential clients;
2. no additional costs for website promotion;
3. advertising campaign can be accurately calculated and all metrics are measurable;
4. you pay for real buyers;
5. collection is carried out in different ways (direct, indirect, automatic, targeted).

Content plays a huge role in social networks (Web.com Academy, nd.b). First of all, the client pays attention to the content, so the lead may not be a selling headline, but a post with a photo of the director's dog. At the same time, there is a problem of leading a lead from the first like to the sale. In modern social networks and programs that help analyze sales in social networks, this problem is not resolved, since there are no metrics evaluating both the work of a lead manager and the quality of leads.

Let's consider how and with the help of what metrics it is possible to analyze the audience in a particular social network Vkontakte , which is the most popular social network according to Brand agency. Analytics (Br-analytics, nd.).

A feature of Vkontakte is to consider the effectiveness of the community by not simply counting the number of subscribers, but the dynamics of its growth. Subscribers should show constant interest, it is the stability of hits that is taken as the basis of the metric. You can view this parameter by going to the "Statistics" section, and then familiarize yourself with the contents of the "Attendance" and "Participants" tabs.

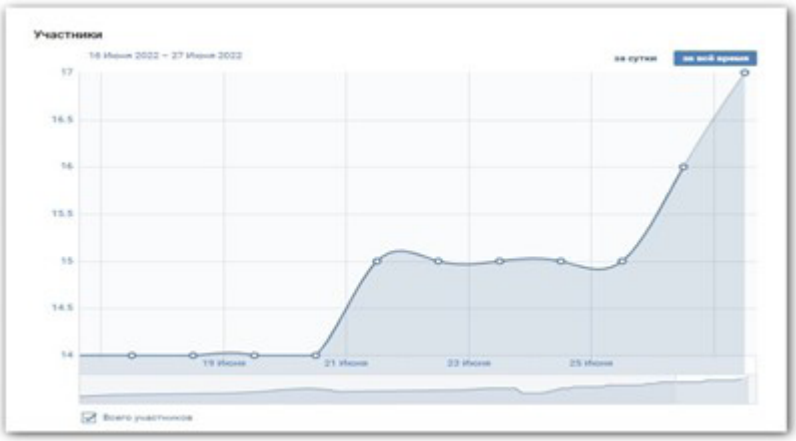


Fig. 1. Dynamics of attendance of the Vkontakte community

It can be noted that Vkontakte takes into account the “Seasonality” parameter, which changes during the holidays, which is especially important for the tourism business under study. You can also use the "Current User Activity" and "Audience Composition" tabs. These tabs allow you to see gender, age, geography and other parameters.

VKontakte provides a comprehensive analysis of user activities. The "Records" tab sorts ac-

tivities by various reactions, from ascending to descending and vice versa.

The most important indicator of a social network is the level of engagement. This indicator takes into account any activity of users in the group. This indicator is especially important for the advertising business. It should be noted that the search for Vkontakte gives communities in the first places according to the combined indicator of the number of subscribers and user activity.

The activity level is determined using several formulas. These formulas take into account a variety of actions in the group: likes, reposts, access to sections of the page, watching videos and listening to audio files. There are engagement rates per day (ERday), by posts (ERpost) and by views (ERview). The following figure shows how these indicators are calculated.

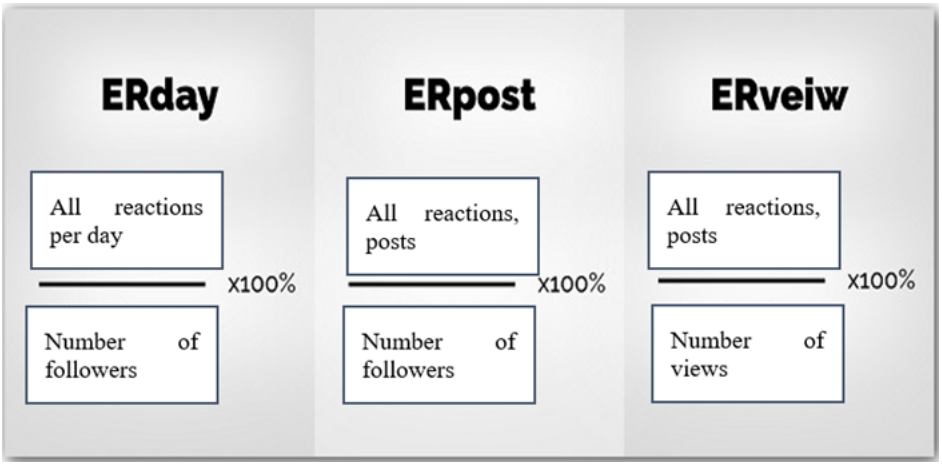


Fig. 2. Calculation of indicators ERday, ERpost, ERview

Vkontakte also allows you to take into account and calculate such important indicators as the reach of an advertisement, reactions to advertisements, the number of targeted actions, and so on.

It should be noted that a huge number of tabs does not allow you to visually and quickly systematize these numerous indicators. If you take into account the large number of social networks, then the software becomes essential.

Programs use average indicators, taking as a basis the methodology provided by the social network itself.

To track the main actions of users that a marketer needs to know, you can use the advertising account of a social network, where the indicators are presented: CTR, SRM and SRC - the number of hits to the number of impressions, the cost of a thousand impressions of an ad and the cost of one target action, respectively.

As can be seen from the above brief analysis, there is no separate lead quality indicator within the social network , which is not surprising, because the lead is the area of competence of the company that uses the social essence as a way of promotion and interest in creating such a metric should come from the business and be built into software products that are designed to analyze the audience of a social network and track lilas .

It should also be noted that despite direct communication with users, all of the listed indicators and metrics are designed to provide implicit information about users.

4. Tasks to be solved by building a simulation model

Having considered the theoretical aspects of lead generation and the features of marketing metrics in the social network Vkontakte , we found out two fundamental drawbacks that impede

effective lead generation:

1. focus exclusively on implicit methods;

2. lack of metrics for assessing lead quality .

Proposing to solve these problems by building a simulation model, we make the assumption that, firstly, it is possible to combine implicit and explicit methods in one technique, and secondly, to create an integral indicator for assessing the quality of leads. The practical implementation of this idea may face many difficulties, however, we can make an attempt to model this process in order to justify the very possibility of such a solution.

The tasks that the construction of the model solves:

1. Create a model of the integral indicator of the lead quality assessment process .

2. Create a model for automating the work of a lead manager.

The problem statement itself suggests a solution in this case. The fact is that in the process of work, the lead manager uses mainly explicit methods of working with information. Thus, our model will contain exactly explicit data, which includes information that the manager receives already when working with a client, which includes the nature of communication, the designation of the timing of the transaction and other data. Entering this data into a computer can be mechanical. However, an algorithm and a program will continue to work that can easily take into account a large amount of data obtained by implicit methods, standard methods of analytics in social networks, for example, content analysis widely used in social networks. In the model presented below, we will not introduce implicit data for the sake of simplicity of the experiment.

It was also proposed to reduce the time spent by smm-specialists and marketers when working with content.

Among the many factors that affect time costs, we have identified the following:

1. The difference in targeted advertising services in various social networks and the need for time spent on working with each service separately (targeted advertising on Vkontakte , Instagram and other social networks).

2. The need for time spent on reporting on advertising.

3. The need for timely tracking of stocks.

Factors 1 to 3 are measured by the amount of time an internet marketer spends on these features. The actual amount of time can be determined by interviewing the firm's employees.

When calculating the effectiveness of the proposed models, we used the figures for time costs provided by the employees of the travel company "Eclectica" on condition of anonymity.

Also, to give the model a scale of the level of socio-economic processes, we introduced an additional factor into the model: the index of digital literacy of Russian citizens (ROCIT, nd.). Numerous researchers have proven that this value directly affects the number of citizens involved in the Internet space, and therefore affects the total number of potential clients of the company, which can be reflected in the model.

4. Building a simulation model in the AnyLogic program

First, in order to show how a lead quality assessment automation system can be created, a model of the integral lead quality indicator was created. Table 2 shows the conventions of the elements used. Table 2 shows the relationship of elements. The following are formulas for calculating dynamic variables and accumulators, as well as the values of statistical variables.

Table 1. Symbols of model elements

Designation	Factor
X1	Understanding where to call
X2	Understanding where no one is calling
X3	Understanding where the bottom line is calling
X4	Transaction deadline within a month
X5	Deadline for a deal within a quarter
X6	Deadline for the transaction within a year
X7	Deal entry time total indicator
X8	Interest in buying
X9	No interest in buying
X10	Interest in buying total
X11	Form of payment in cash
X12	Form of payment non-cash
X13	Form of payment Total value
X14	Willingness to provide data
X15	No readiness to give data
X16	Willingness to give data a final value
X17	Communication is warm
X18	Communication is cold
X19	Final communication
X20	Purchase image is
X21	No purchase image
X22	Purchase image total value
Y1	Integral indicator of lead quality assessment

Table 2. Relationship of model variables

endogenous variables	exogenous variables									
Y1	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20
	X21	X22								

The criterion for assigning a value to an indicator is the target action. Therefore, the units of measurement are called conditional in the model.

Table 3. Values of the statistical variables of the model

Designation	Factor	Factor
X1	1	Service
X2	0	Service
X3		Service
X4	1	Service
X5	2	Service
X6	3	Service
X7		Service
X8	1	Service
Variable	Meaning	Unit measurements
X9	0	Service
X10		Service
Variable	Meaning	Unit measurements
X11	0	Service
X12	1	Service
X13		Service
X14	1	Service
X15	0	Service
X16		Service
X17	1	Service
X18	0	Service
X19		Service
X20	1	Service
X21	0	Service
X22		Service
Y1		Service

Model designations: Y1 = X3 + X7 + X10 + X13 + X16 + X19 + X22

In the model below, X3 , X7, X10 , X13, X16, X19, X22 are dynamic quantities in the terminology of the Anylogic program.

Y1 Integral indicator - accumulator, other values - parameters with values specified by the manager. Next, a model was created to reduce the time spent by the lead manager. Table 1 shows the conventions of the elements used. Table 2 shows the relationship of elements. The following are formulas for calculating dynamic variables and accumulators, as well as the values of statistical variables. Since, on average, the implementation of a particular function (writing a report) takes 1 working hour, hours are taken as a unit of time.

Table 4. Symbols of model elements

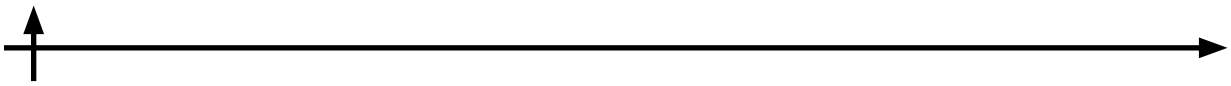
Designation	Factor
X1	Waste of time tracking the target before implementation
X2	Waste of time tracking the target after implementation
X3	Time reduction
X4	Waste of time reporting on ads before implementation
X5	Waste of time reporting on ads after implementation
X6	Time reduction
X7	Waste of time tracking the end of the promotion before implementation
X8	Waste of time tracking the end of the promotion after implementation
X9	Time reduction
X10	Number of target actions
X11	Number of leads
X13	Number of sales
X14	Number of visitors
X15	Digital Literacy Index
Y1	Time costs of an Internet marketer
Y2	LCR (Lead Conversion Rate)
Y3	Total sales conversion taking into account lead generation

Table 5. Relationship of model variables

endogenous variables	exogenous variables									
Y1	X1	X2	X3	X4	X5	X6				
Y2	X11	X10	X9	X8	X7					
Y3	X13	X14	X15							

Table 6. Values of the statistical variables of the model

Variable	Meaning	Unit measurements
X1	87.5	watch
X2	4.17	watch
X3	95.23	%
X4	16	watch
X5	0.25	watch
X6	98.44	%
X7	1	watch
X8	0.1	watch
X9	10	%
X10	100	Pieces per month
X11	50	PC. per month
X13	50	PC. per month
X14	100	PC. per month
X15	30	%
Y3	50	%
Y1 (X3, X6, X9)	95.23; 98.44; 10	%
Y2	100	%



The time spent by the marketer will be calculated using the formula:

Y1 = X3, X6, X9. X = 100% -100% / z, where z = X1 / X2, where X1 is the time that was spent before the implementation of automation, and X2 was the time spent after the implementation.

Y2 = LCR (Lead conversion Rate) = number of leads X12 / X14 number of website visitors x 100

Y3 = Total conversion taking into account lead generation CR = number of sales / number of leads x 100%

The number of potential customers (website visitors) increases depending on the digital literacy index:

$$X14 = 100\% - X15$$

From the data presented, it can be seen that the largest items of time spent by a lead manager are the costs of tracking advertising campaigns.

The time spent by the marketer will be calculated using the formula:

Y1 = X3, X6, X9. X = 100% -100% / z, where z = x1 / x 2, where x 1 is the time that was spent before the introduction of automation, and x 2 is the time that was spent after implementation.

Y2 = LCR (Lead conversion Rate) = number of leads X12 / X14 number of website visitors x 100

Y3 = Total conversion taking into account lead generation CR = number of sales / number of leads x 100%

The number of potential customers (website visitors) increases depending on the digital literacy index:

$$X14 = 100\% - X15$$

In the general table, the indicator of leads after optimization is deliberately omitted - X 12 . To date, there is no established methodology for assessing the quality of leads and the proposed model needs theoretical refinement and additional justification, we took an arbitrary value for further calculations. X12 will be 2 more than the number of leads before X 11 optimization , this will reflect the trend of increasing lead efficiency. X12 = 2 * X11.

Parameters were introduced into the model: time spent tracking the target before implementation, time spent tracking the target after implementation, time spent reporting on advertising before implementation, time spent reporting on advertising after implementation, time spent tracking the end of the promotion before implementation, wasting time tracking the end of the promotion after implementation, the number of leads before optimization, the number of leads after optimization, the number of sales, the number of visitors, the digital literacy index. LCR metrics , overall sales conversion, and reduced marketer time lead to an cumulative increase in marketing effectiveness.

And also the activity agent lead -manager was introduced into the model.

This step is due to the fact that there can be many agents and the method of agent- based modeling can establish relationships between similar agents.

This option is relevant for large teams and companies with a large number of agents. In our case, the agent is introduced to show the possibilities of modeling.

Also, a table of parameters for the effectiveness of implementing automation of the work of an Internet marketer and automation of lead assessment was created.

Table 7. Performance indicators for the implementation of process automation

Name	Before automation	After automation	%	Reduced / Result
Tracking the effectiveness of advertising	87.5	4.17	95.23	18,228.44
Making report	16	0.25	98.44	3445.31
End of promotion	2	1	50	50
LCR (Lead Conversion Rate)	50	100	50	
Overall sales conversion rate including lead generation	50	100	50	
Other effects of the introduction of automation				Monitoring the work of Internet marketers Increasing support Increasing customer loyalty

As a result of the simulation, it was revealed that the automation system for the work of the lead manager significantly reduces the time spent on tracking the effectiveness of advertising campaigns in targeted advertising, compiling reports, and informing specialists about the end of promotions for a particular client was added. A novelty for this kind of projects was the addition of a lead scoring automation system, which led to a significant increase in conversion rates.

Conclusion

As a result of this research two models were designed: a model of an integral indicator of the quality of a lead and a model for automating the evaluation of leads and the work of a lead manager. These models are presented below.

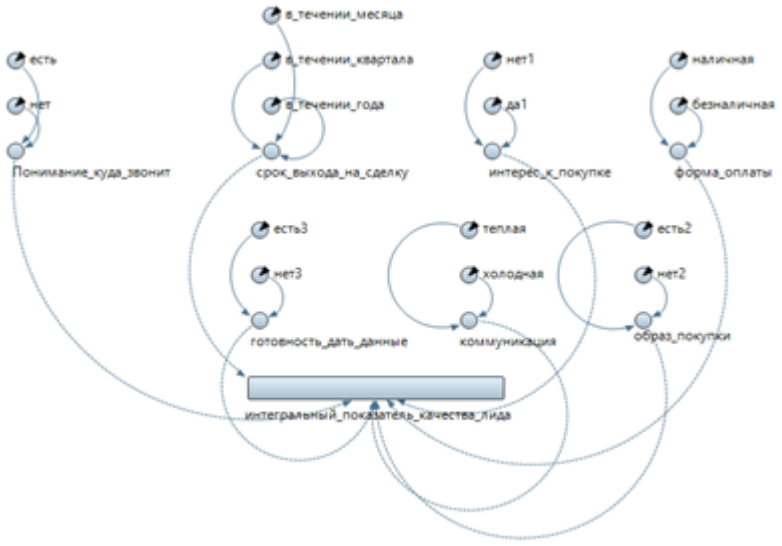


Fig. 3. Simulation model of the integral indicator of lead quality in the AnyLogic program

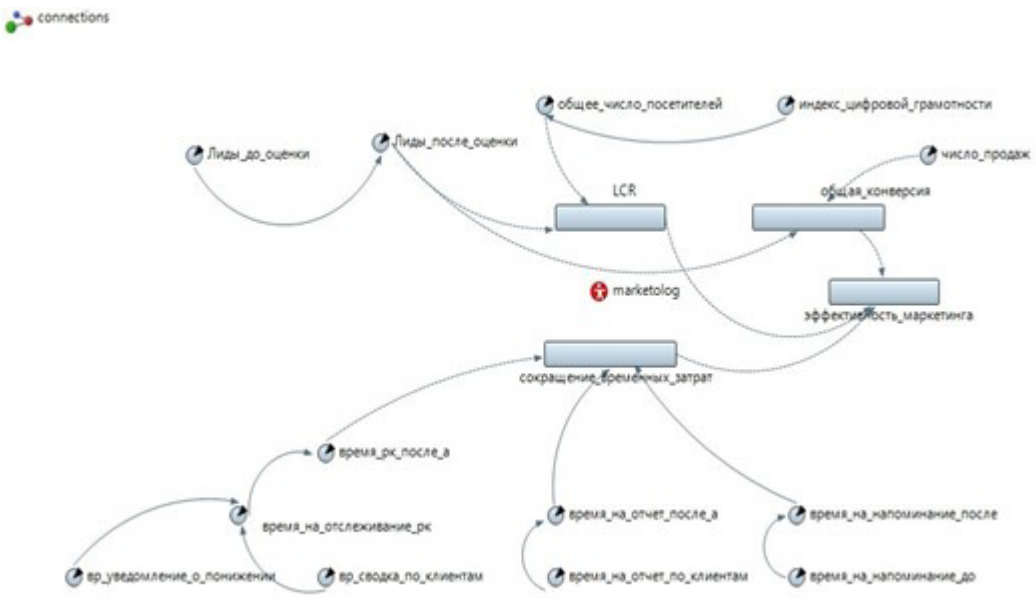


Fig. 4. Simulation model for automating the lead assessment process and reducing the time spent by a SMM specialist in the AnyLogic program

These models are simulation, which means that not all real parameters are taken into account. However, we took values close to real, obtained, among other things, thanks to a survey of smm specialists from the Eclectic company. The model was launched in the AnyLogic software environment and gave a positive result (AnyLogic, nd.). The data obtained as a result of the study can be used in real work to create a system for automating the assessment of lead quality. It should be especially noted that in the course of the analysis of market trends and the opinions of marketing experts given in this article, the need for such projects is steadily growing.

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ASSESSMENT OF PROCESS MATURITY AT SERVICE COMPANIES

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Abstract. Assessing process maturity of network service companies allows not only to get an idea of the current level of work with business processes, but also to see shortcomings and shortcomings in their description and help managers make informed management decisions to achieve business development goals. Today, there are various models of maturity levels, but they are all based on the evolutionary, consistent development of the organization. It is important to understand that changes related to the improvement of the management system may not occur sequentially: in some areas, the company can move far, in others, on the contrary, it can lag far behind. Therefore, maturity levels can overlap, making it difficult to determine the exact stage of a firm's development. In this regard, in this study, it is proposed to assess the level of process maturity based on the following system methods and models: Capability Maturity Model Integrated (CMMI), Business Process Management Maturity Model (BPMMM), and Process and Enterprise Maturity Model (PEMM).

Keywords: process maturity, business process, service company

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ОЦЕНКА УРОВНЯ ПРОЦЕССНОЙ ЗРЕЛОСТИ СЕРВИСНЫХ КОМПАНИЙ

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Аннотация. Оценка процессной зрелости сервисных компаний позволяет не только получить представление о текущем уровне работы с бизнес-процессами, но и увидеть недочеты и недоработки в их описании и помочь менеджерам принимать взвешенные управленческие решения для достижения целей развития бизнеса. Сегодня существуют различные модели уровней зрелости, но все они базируются на эволюционном, последовательном развитии организации. Важно понимать, что изменения, касающиеся совершенствования системы управления могут происходить не поочередно: по одним направлениям компания может продвинуться далеко, по другим, наоборот, сильно отставать. Поэтому уровни зрелости могут накладываться друг на друга, в результате чего определить точную стадию развития фирмы бывает достаточно затруднительно. В этой связи в данном исследовании оценку уровня процессной зрелости предлагается провести на основе следующих системных методик и моделей: Capability Maturity Model Integrated (CMMI), Business Process Management Maturity Model (BPMMM), а также Process and Enterprise Maturity Model (PEMM).

Ключевые слова: процессная зрелость, бизнес-процесс, сервисная компания

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Introduction

High level of competition, growing needs and expectations of customers, rapid development of IT infrastructure, sharp aggravation of economic and political instability of the country force the company to continuously update and improve its activities in order to instantly adjust to changes in the external environment and improve the performance of its activities. Today it is becoming increasingly difficult for most organizations to maintain a competitive advantage. A wide range of offered goods and services, the use of advanced technologies, high quality of service and other factors of maintaining competitiveness have long been transformed into minimum conditions of presence in the market. To date, it is impossible to solve the issues of improving the efficiency of business entities without the formation of their effective business model.

In this context, the more competitive a company is, the better it is able to take into account not only the changing market conditions, but also to analyze and adjust to market requirements its internal business environment, represented by various elements that are aimed at creating value and turning this value into profit. In order to develop a unified view of the mechanism of a particular business unit, it is necessary to understand what actions and in what sequence are performed in the company on the way to creating a useful product for consumers and achieving

the desired results of activity. In this, the firm is helped by identifying and analyzing the business processes that form the basis of its business model.

It is the description of the processes running in the organization that allows to see a holistic picture of its work, to identify the reasons preventing the achievement of the set goals, and to develop recommendations for their elimination to improve the financial and economic performance of the company as a whole, and to further optimize the totality of business processes. For network trading companies, careful monitoring of the maturity of current business processes is crucial for the development of promising measures for further improvement. In this study, the specifics of business processes, as well as the assessment of their maturity level, taking into account the key performance indicators of the main business processes is carried out on the example of the company "Communications and Radio Navigation", supplying and servicing of marine radio-navigation equipment and communications. Today this company is the leader in terms of the number of engineers among service companies in the field of communication and navigation maintenance on the operating fleet in the Russian Federation.

Materials and Methods

The methodological basis of the study is: collection and analysis of information, comparison, description, classification and generalization. The theoretical basis of the study was the works of domestic and foreign authors: on the formation of the business model (A. Osterwalder, I. Pinje, G. Hamel, W. Chan Kim, R. Mobarn, etc.), on the basics of the process approach to management and business process modeling (A. Koptelov, V. Repin, V. Eliferov, I. Fedorov, etc.). The company's financial statements were also used as sources of information.

Results and Discussion

Against the background of high level of competition and growing customer needs, the most important tools used to improve business efficiency are methods of modeling and evaluating business processes (Dolganova and Vinogradova, 2016; Kamennova, 2019). In order to adjust to the business environment and not to lose the pace of development, companies are actively using software tools to describe and optimize their activities. The ultimate goal of using such techniques and software tools is to modify business processes and, as a consequence, improve financial and economic performance, improve product quality, increase the degree of satisfaction of external and internal customers, implement automation systems, etc.

The fundamental basis of modern approaches to management is the process approach, which provides a methodological basis for continuous improvement of the organization's activities. According to GOST R 54985-2018, the process approach implies the use by a company of a system of processes along with their identification and interaction, as well as the management of these processes in order to obtain the desired result (GOST R 54985-2018, 2013). In turn, a business process is understood as a periodically repeated, controlled activity to transform "inputs" (raw materials, semi-finished products, information, etc.) into "outputs", that is, into a useful product or service for the customer.

In contrast to the functional approach, focusing on individual functions, works and performers, the process approach does not emphasize the efficiency of individual fragments (functions), but the efficiency of the process as a whole, the flow of events to create value. It allows you to see a holistic picture of the firm's work, to evaluate all its actions in terms of the final result, as well as:

– helps to structure the company's problems and their impact on each other;

– gives the opportunity to develop, not limited to one-off remedial actions, but systemati-

cally, systematically solving problems;

– makes it possible to simultaneously build effective management for the medium and sometimes even long-term perspective as current problems are solved (Silich and Silich, 2011).

By implementing the process approach, the company creates a management system that will be aimed at the effective development of the organization by managing each significant business process throughout its life cycle. And the quality of this management can be assessed by evaluating the level of process maturity of the company. Management maturity refers to the process of continuous improvement of the firm's activities through continuous improvement of the strategic management methodology and its integration into the overall management system of the organization. It is important not to confuse the concept of process management maturity with business process maturity (Repin and Eliferov, 2013; Mashtakov et al., 2023). If the maturity level of a certain process allows us to determine its degree of compliance with the criteria of certainty, manageability, controllability and efficiency, the maturity level of an entire company shows how successful it is in managing the totality of these processes.

One of the most common models used in practice today is the Capability Maturity Model Integrated (CMMI). It consists of three methodologies aimed at assessing different areas of a company's work with the purpose of their subsequent improvement (People CMM, nd.; RBC Information Agency, nd.).

CMMI was developed in the late 80's of the XX century by the US Software Engineering Institute at Carnegie Mellon University as a tool allowing large government organizations to select the best software vendors. Further refinement and improvement of the model gave it a unified form and made it suitable for assessing various aspects of any organization's activity, including the level of process management development.

To assess the level of a company's process maturity, CMMI proposes to use a scale of five levels, shown in Fig. 1.

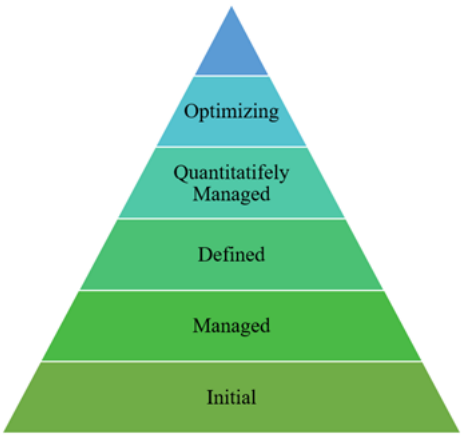


Fig. 1. Process maturity levels

Level 1. "Initial". At this level, business processes in the company are not described and are poorly controlled. The firm's activities are a bit haphazard, there is no certainty about the future, there are no internal regulatory documents, and the quality of work performed is not always stable.

Level 2. "Managed". At this stage, the company's processes are outlined only at the project level. Standards are appearing that allow planning, implementing, measuring and controlling

them. However, there are still many unresolved issues.

Level 3. "Defined". All major business processes at this level are defined and documented. Management already has a target picture of the company's operations and the processes in place to achieve the strategic objectives.

Level 4. "Managed based on quantitative data". At the fourth stage, the implementation of all the organization's processes is tracked, monitored and measured against pre-formulated performance indicators. Also for companies of this level is characterized by the use of special software tools for process management.

Level 5. "Optimizable". At the final stage, the company actively manages business processes, constantly improving and perfecting its activities (Vasilieva, 2012).

Organizations that have reached Level 4 and 5 have highly mature process management, continuously evolving, adapting, and going beyond their scope to create new, better value propositions for customers (Volovik, 2020; What is CIMM, nd.).

Another fairly common model is the Business Process Management Maturity Model (BPMMM). The BPMM model, developed by the research and consulting company "Gartner", is designed to help companies overcome all barriers to the successful implementation of the BPM concept and to form such a corporate business process management strategy that would meet all the business objectives of the organization. BPMM represents six stages of a company's maturity in terms of managing its business processes (see Figure 2).

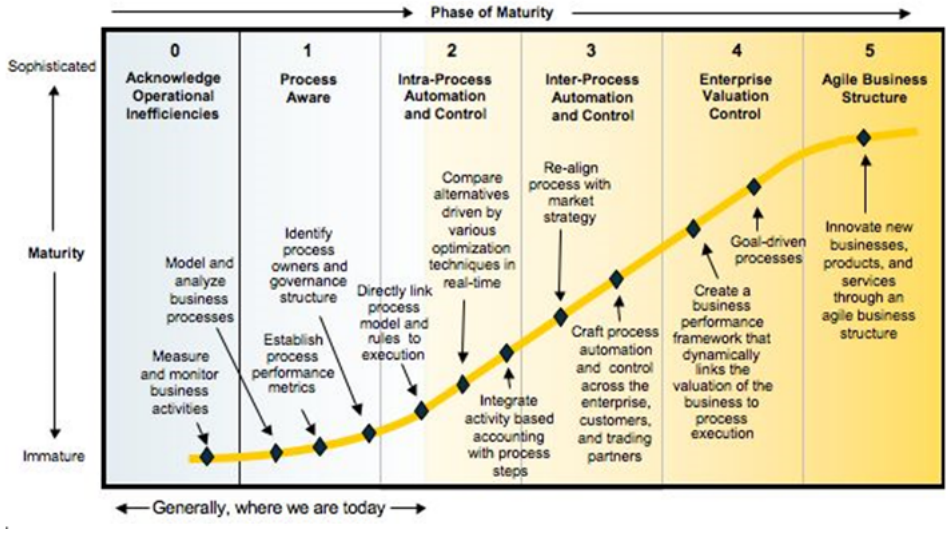


Fig. 2. Six stages of the company's process maturity

The journey to a fully process-oriented organization begins at Stage 0 ("Recognition of Operational Inefficiency") with the realization that traditional approaches to business improvement will not yield meaningful results. The need to find effective ways of development leads it to the first stage - "Process Engagement" - where the firm begins to build a business process management system and create metrics to assess its performance.

As the company becomes more aware of the processes, it begins to regulate them and automate some of them for execution control (phase 2). Gradually, the boundaries of individual business processes expand, and in phase 3 the organization begins to integrate them with each other, as well as with the processes of key partners and customers (Pirogova, 2017; Ilin et al., 2017).

Phase 4 ("Value Chain Management") comes when the company creates a model in which

the strategic and operational goals of the business are closely aligned with the business processes being implemented. Ultimately, all these activities lead the firm to create a flexible business structure (stage 5) that can adapt existing processes and create new ones in response to changes in the external and internal environment.

The peculiarity of this model is that simultaneously with all maturity stages the improvement of the company's process management is also considered within the framework of six organizational factors, which should develop in parallel and in a balanced way as the firm moves from stage to stage (see Figure 3 and Table 1).

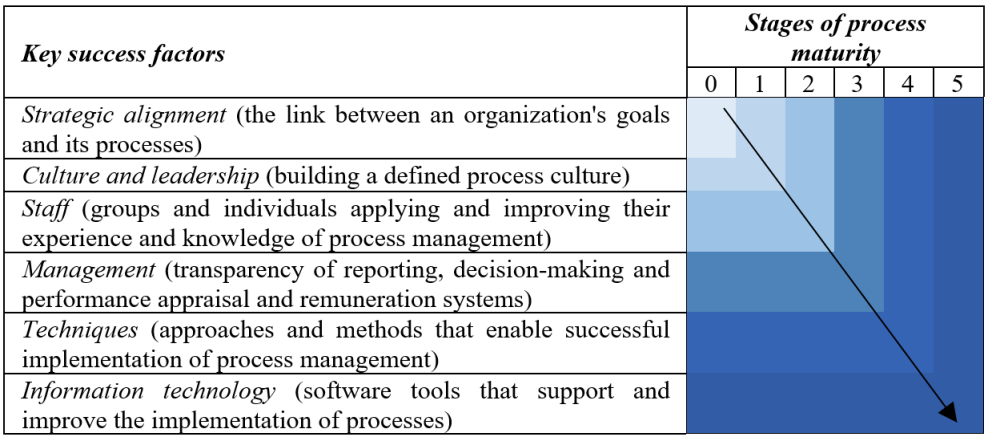


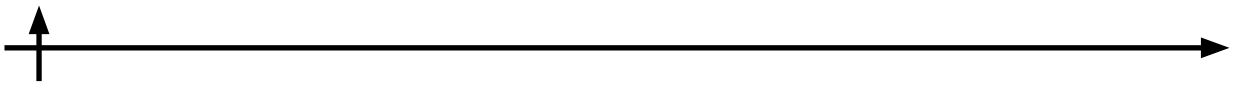
Fig. 3. Organizational factors of BPMMM

If the previous two models touched upon different aspects of the process management system, then, for example, the People CMM (People Capability Maturity Model) proposes to consider the level of process maturity based on the assessment of personnel management (People CMM, nd.).

According to this model, there are five levels of process maturity (see Table 2), which can be taken literally as a chronological sequence of development and improvement of personnel management practices.

Table 1. Comparison of EasyMerch and iSellMore systems

№	Level	Focal aspect of development	Typical features
1	“Initial”	Non-systemic management	Recognizing the dependence of the company's performance results on the quality of personnel work
2	“Managed”	HR management	Training and development; work environment; performance management; communication and coordination
3	“Defined”	Competence management	Personnel planning; competency-based work; career development; culture of belonging; competency analysis
4	“Forecasted”	Opportunity management	Capability management; quantifying staff performance; mentoring; competence as an asset
5	“Optimizable”	Change management	Innovations in personnel management; continuous development of capabilities; alignment of performance with company goals



Despite the universality of this model, analyzing the process maturity of a company by only one aspect will be considered incomplete. However, the assessment should be carried out comprehensively, touching upon as many areas of business process management as possible (Koptelov, 2019a; KPI system, nd.; Khazieva, 2021).

For a comprehensive assessment of the process maturity of companies operating in the market of radio navigation equipment service, it is possible to use a four-level model PEMM (Process and Enterprise Maturity Model), which was proposed by Michael Hammer (Hammer, 2007).

The author suggests that enterprise maturity should be assessed along four dimensions, viz: "Leadership", "Culture", "Business Process Specialists" and "Process Management Structure".

In turn, for each aspect the directions of analysis are defined. For example, "Culture" involves assessing:

– teamwork;
– the degree of the company's orientation towards consumers;
– the degree of personnel responsibility for the results of processes;
– the attitude of employees to changes.

For each area, statements are prescribed, which are entered in the columns of the table corresponding to one or another maturity level (Koptelov, 2019b; Melenovsky and Sinur, 2006).

Conclusions

Assessment of process management is carried out by collecting data on the basis of which it is possible to determine by expert judgment the degree of compliance of each of the presented statements with the real state of affairs in the company:

– if the statement is true or at least 80 % true, the corresponding cell is colored green (or 80 + is spelled out);
– if the company is not sure that the statement is true, the cell is colored yellow (20-80);
– if the statement is mostly incorrect or less than 20% correct, it is colored red (20 -).

Table 2 presents a detailed assessment of the maturity level of the process management of the company "Communication and Radio Navigation" on the following aspects: awareness, distribution of responsibilities, action style, teamwork, attention to customers.

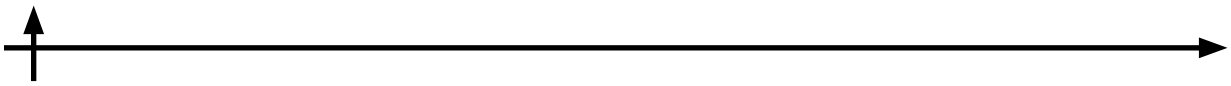
Table 3 presents a detailed assessment of the maturity level of the process management of the company "Communication and Radio Navigation" on the following aspects: responsibility, attitude to change, people, methodology, business process model, responsibilities, work coordination (Presentation of the company SIR, nd.).

Table 2. Maturity level of the process management at "Communication and Radio Navigation" (aspects: awareness, distribution of responsibility, action, style, teamwork, attention to customers)

	P-1	P-2	P-3	P-4	P-1	P-2	P-3	P-4
Awareness	Company bosses recognize the need to improve operational efficiency, but have little understanding of the benefits of processes	At least one member of senior management is well versed in the concept of business processes and knows how it can be used to improve efficiency	Senior management perceives work in the company as a set of business processes and knows what needs to be done to improve efficiency	Management sees its own work as a single process, and business process management is perceived not as a project, but as a way of doing business in the company	85	80	60	18
Distribution of responsibility	Processes are implemented by middle managers	A member of the management team takes responsibility for implementing the processes	All members of senior management support the process implementation program. Many employees help with the redesign of business processes	Employees are excited to work in a new process-oriented environment and are willing to take leadership roles on new projects	85	70	15	0
Actions	A member of the management team supports projects to improve the company's performance	Top management has set a goal for the company to take customer service to new levels	Members of senior management work as a team, they manage the company through processes and actively participate in the process approach implementation program	Senior management members build on processes to do their own work, conduct strategic planning, and set new performance improvement goals	90	80	30	13
Style	A shift from an authoritarian, hierarchical style to open collaboration has begun within the leadership ranks	Management representatives managing process implementation are fervent advocates of process-based business transformation	Senior management representatives assigned responsibility for process implementation to process managers and empowered them with the necessary authority	Management directs processes by influencing and setting benchmarks to strive for, rather than by directives from above	90	45	10	0
Teamwork	People only come together as a team when a project is in progress	Cross-functional teams are constantly working on efficiency improvements	Teamwork is common among process participants and managers alike	Working on the same team with customer and supplier representatives is commonplace in the company	50	10	0	0
Attention to customers	Many people have heard about the importance of paying attention to customers, but few realize what those words mean	Employees understand that the purpose of their work is to create special value for the customer	Employees understand that customers require high quality products and perfect service	The Company cooperates with partners to improve the quality of customer service	95	95	80	65

Table 3. Assessment of maturity level of the process management at "Communication and Radio Navigation" (aspects: responsibility, attitude to change, people, methodology, business process model, responsibilities, work coordination)

	P-1	P-2	P-3	P-4	P-1	P-2	P-3	P-4
Responsibility	Responsibility for results lies with managers	Private employees are also beginning to be held accountable for the results of processes	Employees feel accountable for the performance of the entire company	Employees believe their goal is to serve customers to the highest standard and achieve greater company efficiency	90	70	15	0
Attitude to change	Many managers are beginning to accept the need to make small changes in the way the company operates	Employees are ready for major changes in the way they do their work	Employees are ready for major changes at all levels of the organization	Employees realize that change is an integral part of the company's work and are completely comfortable with it	90	40	18	0
People	Several people in the company are convinced of the effectiveness of the process approach	The company has specialists trained in process redesign and implementation, change management methods	Business process specialists have skills in implementing large-scale projects and experience in business transformations	The company has quite a few specialists in the field of process redesign and implementation, change project management	80	30	10	0
Methodology	The company uses one or more methodologies for executing programs and conducting step-by-step process improvements	Process design teams can utilize a business process-based transformation methodology	The company has developed and approved a BP redesign process, and it is integrated with business process improvement standards	Process management and process re-engineering are becoming key elements of the company's system of work	35	19	0	0
Business process model	Several business processes have been defined in the company	The company has developed and approved a complete business process model	The business process model includes each employee, and on its basis the priority of projects is established. In the company's information systems integration model	The business process model provides the ability to collaborate with suppliers and customers. Management uses the model in developing the strategic planning plan	85	50	5	0
Responsibilities	Department managers are responsible for productivity in their area, project managers are responsible for improving efficiency	Process managers oversee the implementation of their processes and the steering committee is responsible for the execution of business process implementation projects	Process managers are responsible for ensuring efficiency	The Business Process Council is the main governing body; implementers are jointly responsible for performance	95	40	15	0
Work coordination	One or more work groups use their own methods to improve efficiency	An informal coordinating body manages the change program and a steering committee allocates resources for business process redesign projects	The company has formalized a business process implementation department headed by a business process director	Process managers work with their counterparts at buyer and supplier companies to improve collaboration efficiency	65	5	0	0



In general, it can be stated that at the moment the analyzed company is between the first and the second maturity level. The management is convinced of the effectiveness of the process approach, they are aware of the need to make changes in the firm's work so that it can be as customer-oriented, flexible and able to respond quickly to the challenges of the external environment.

However, in order for the company to reach a new level of maturity, the management needs to convey its conviction to all employees, create a logical and understandable concept of process approach implementation. It is also important to create a corporate culture that will encourage staff to work as a team, develop their involvement in the company and instill responsibility for the results of its work.

The next step may be the formation of a special unit (process office or competence center), which will play a key role in the organization and management of continuous improvement of business processes through process management. If the company provides conditions for accumulation and utilization of knowledge and experience of structural units in process management, then it will gain significant advantages in relation to its closest competitors, as it will be able to promptly manage business processes and ensure their continuous improvement to increase the efficiency and effectiveness of the entire firm's activities.

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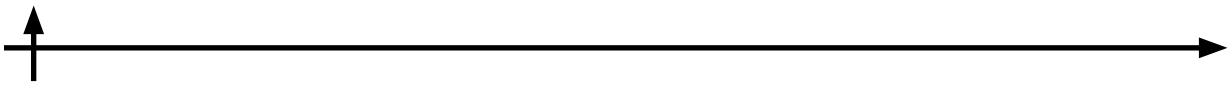

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INFORMATION SYSTEMS IN THE ORGANIZATION OF BUSINESS PROCESSESS OF FUNERAL COMPANIES: FEATURES OF EFFICIENCY ASSESSMENT

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Abstract. Currently, information technologies are necessary for effective activities in any area of society, including state and municipal government. Automation and digitalization of the state activity processes are an important step in the development of a modern government. The purpose of this research is to study the possibilities of workflow and management automation processes, and distinguish peculiarities of efficiency assessment at funeral companies taking into consideration current trends in business processes at municipal organizations. In the course of the research, the authors identified promising areas for automation, analyzed prerequisites for funeral and ritual processes automation, and identified problems requiring IT support. As a result, a comprehensive assessment of efficiency of existing IT solutions for workflow and management processes in funeral and ritual activities was carried out based on the "AS IS" model.

Keywords: information systems, funeral companies, "TO BE" model, "AS IS" model, document management, economic efficiency

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ОСОБЕННОСТИ ОЦЕНКИ ЭКОНОМИЧЕСКОЙ ЭФФЕКТИВНОСТИ ИНФОРМАЦИОННЫХ СИСТЕМ В ОРГАНИЗАЦИИ БИЗНЕС-ПРОЦЕССОВ РИТУАЛЬНЫХ КОМПАНИЙ

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Аннотация. В настоящее время информационные технологии необходимы для эффективной деятельности в любой сфере общества, в том числе и в государственном и муниципальном управлении. Автоматизация и цифровизация процессов государственной деятельности являются важным шагом в развитии современного государства. Целью данного исследования является изучение возможностей автоматизации процессов документооборота и управления, а также выявление особенностей оценки эффективности на предприятиях похоронной отрасли с учетом современных тенденций развития бизнес-процессов в муниципальных организациях. В ходе исследования авторы определили перспективные направления автоматизации, проанализировали предпосылки для автоматизации похоронных и ритуальных процессов, выявили проблемы, требующие IT-поддержки. В результате, на основе модели "AS IS" была проведена комплексная оценка эффективности существующих IT-решений для автоматизации рабочих и управленческих процессов в похоронно-ритуальной деятельности.

Ключевые слова: информационные системы, ритуальные компании, модель "TO BE", модель "AS IS", управление документооборотом, экономическая эффективность

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Introduction

The presence and use of information technology are necessary for effective activities in any area of society, including state and municipal government. Nowadays, when technology is rapidly developing, automation is becoming essential for processes of most spheres, as it allows to reduce the time and cost of completing tasks, improve the quality of services provided, and increase the efficiency of employees. Automation and digitalization of the state activity processes are an important step in the development of a modern government (Biryukova and Rostova, 2020; Klimova, 2022; OpenAgent, nd.). Today many government organizations are actively implementing new technologies and systems that automate many processes and simplify work with citizens and their appeals. One of the main tasks of state activity automation is to improve the quality of services that are provided to citizens. With the use of modern technologies, it is possible to significantly speed up the process of providing services, reduce waiting time and the amount of paperwork. In addition, automating government processes can reduce the number of

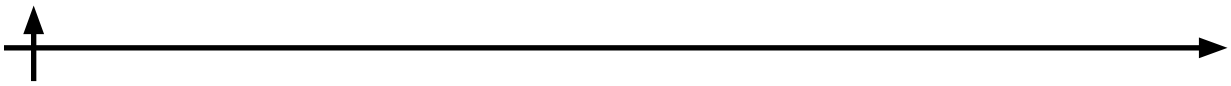
mistakes and simplify the task execution control.

However, despite the fact that the automation of public services has long since become a reality, many areas of public activity still need digitalization and automation. Modern realities require all spheres of activity (from government to commercial) quickly and effectively problem-solving, including the sphere of funeral and ritual activities. One of the key aspects of this area is a document management and management of processes related to the organization of funeral and ritual services.

The relevance of the research topic is explained by the low level of automation and digitalization of decease registering and funeral organization processes in the Russian Federation. Government services in the funeral area are presented in the format of in-person visits to organizations. In terms of the provision of funeral and ritual services, interaction with relatives of deceased people is usually carried out using e-mail, phone calls or in the format in-person visits to funeral organizations. Despite the presence of automation in some cemeteries, crematoria and funeral organizations, there are no information systems able to automate the full cycle of processes in the field of funeral and ritual activities – from appeal registering about the fact of the decease to burial. The market of such information systems and technologies in the area of funeral services in Russia is underdeveloped. Also, the legislative sphere of the Russian Federation plays an important role in the justification relevance of the research topic (Federal law N 149-FZ from 27.07.2006; Federal law N 443-FZ from 21.11.2022; Law of the Kirov Region from 10.11.2015 N 591-ZO). Legislatively, the funeral and ritual industry is regulated and systematized in law «About Burial and Funeral activities» of 1996 (Federal law N 91300-8 from 21.03.2022). That is, nowadays, the legislation does not provide the use of information technology within the processes of ritual and funeral activities. However, since 2022, discussions have been underway at the legislative level on a draft law that will make it possible to adapt the existing processes of funeral and ritual activities to the modern realities of digitalization of the public services provision.

Automation of workflow in the provision of public services is an important step towards improving the quality of service to the population and optimizing the work of government organizations. The automated workflow allows faster processing of citizen requests and appeals, reduces the number of errors, and simplifies the procedure for submitting and receiving documents (Golubeva, 2005). Automation also reduces the time spent on routine tasks, allowing government employees to focus on more important tasks. One of the main advantages of workflow automation is the ability to provide services online. This allows citizens to stay at home and save their time. In addition, automation reduces corruption risks, as all processes become transparent and controllable. Thus, automation of document flow in the provision of public services is a necessary step towards improving the quality of life for citizens and optimizing the work of government organizations. That is exactly why current assessment of economic efficiency of any enterprise should primarily focus on this factor.

In recent years, the Russian government has been actively working towards digitizing its operations and improving interdepartmental interaction (Gosuslugi, nd.a; Gosuslugi, nd.b; Gosuslugi Spb, nd.). To achieve this goal, the government has been investing in various IT-solutions and technologies that can enhance communication, optimize processes, and improve efficiency. One of the most significant IT-solutions that the Russian government has implemented is the Unified System of Interdepartmental Electronic Interaction (SMEV). The Unified System for Interdepartmental Electronic Interaction is a federal state information system created to provide the realization of interdepartmental information interaction between the information systems of SMEV participants to provide state and municipal services and perform state and municipal functions in electronic form (SMEV3, nd.). SMEV has two generations: SMEV 2



and SMEV 3. Since January 2015 based on the Decree of the Government No. 1222 «On the further development of a unified system of interdepartmental electronic interaction» the development of electronic services within SMEV 2 has been discontinued. Disabling existing services in SMEV 2 began in 2017. However, some services continue to work in SMEV 2. Participants in the SMEV (members of the SMEV) are federal executive authorities, regional executive authorities, state and municipal organizations, multifunctional centers, and other organizations.

Materials and Methods

This research invites the methods of extensive data collection and analysis, business process modelling as a tool to assess potential bottlenecks in assessment of economic efficiency of a funeral enterprise. Evaluation of project effectiveness is also represented in this paper. The obtained information was classified in accordance with relevant trends in document and workflow management at funeral enterprises via the implementation of up-to-date methods of assessment of business processes, together with general scientific methods: analysis and synthesis; comparison; classification.

Results and Discussion

Nowadays, there is no solution on the Russian software market that allows the complex automation of the funeral and ritual sphere processes. Citizens who are faced with the decease of relatives and someone else are forced to go through several organizations in order to get the necessary documents for organizing the burial, and then search the most suitable funeral organization based on budget and services. The activities of funeral and ritual organizations are also poorly automated, interaction with applicants and clients is carried out through communication with ritual agents (Bentley, 2010; Popov, 2016).

Automation of the internal processes of funeral organizations has also become necessary, although a number of funeral services are considered difficult to automate. But nowadays information technology is increasingly being implemented in those industries that were previously considered non-automated (Biryukova and Rostova, 2021; Farnieva and Kulaeva, 2020). The premises that the ritual activities should be automated become more and more obvious. Firstly, young people with good skills in information technologies are increasingly appearing in the funeral organizations' management. Secondly, the number of workplaces equipped with desktop computers or laptops is increasing in funeral organizations. Thirdly, funeral organizations' management is realizing that business process automation can increase service speed and customer satisfaction and, as a result, gain a competitive advantage over similar organizations. Such premises indicate that the level of readiness of funeral organizations for automation is increasing.

Process analysis is usually associated with identifying all the participants involved in existing processes. Identifying the participants involved in processes allows more accurate determination of each participant's goals and objectives, as well as identifying possible problems and bottlenecks in the processes (Kraichik and Naidyonysheva, 2016; Levina et al., 2017; Li and Chen, 2009). Overall, identifying participants and determining their roles in processes is an important step in describing processes, which ensures effective interaction between process participants.

Participants involved in the processes of a decease registering and organizing a funeral are presented in Table 1.

Table 1. Participants involved in the processes of a decease registering and organizing a funeral

№	Participant	Main objective within considered processes
1	Citizen	To register a decease To organize a funeral
2	Ambulance	To state the decease fact
3	Police	To examine the deceased body
4	Organization for transportation the deceased to the morgue	To transport the deceased to the morgue
№	Organization	Main objective within considered processes
5	Morgue	To conduct forensic examination To preparate the deceased for burial
6	Registry office / Multifunctional center for the providing the state and municipal services (MFC)	To register a decease
7	Cemetery / Columbarium administration	To provide a burial place / columbarium niche
8	Crematorium (in case of cremation)	To cremate
9	Funeral organization	To organize a funeral To provide ritual services

It should be noted that a citizen needs to apply both to state institutions and to commercial ones.

As part of the analysis of existing workflow and document management processes of funeral and ritual activities, a simplified «AS IS» scheme was created. The simplified «AS IS» scheme presented in Figure 1 shows the activities that are performed by citizen within the processes, and also displays a list of documents and organizations involved in the processes. The scheme can be used for initial introduction to the problem and the area, as well as for the initial analysis of existing processes and identification of problem areas that may require optimization or automation.

In order to get a bigger picture of existing issues it was important to generate a simplified «AS IS» scheme. Based on the assessment of the existing process of organizing a funeral, the following problems were identified:

– lack of automation of the process: only one document (the decease certificate) can be requested electronically, but anyway, to get it, the citizen will need to visit the organization);

– lack of integration between organizations involved in funeral and ritual processes: all organizations are not connected with each other in any way and nowadays they are in different information fields, also, organizations do not have one common supervising body that will control their activities;

– need to visit several instances to obtain the necessary certificates and documents by the citizen (often the problem is aggravated by the emotional state of the citizen): citizen needs to get at least 10 documents, most of which are issued in different organizations, as well as only in paper form;

– opacity of processes: in the open information space there is no detailed information about the process of decease registering and organizing a funeral in the form of a single source, in order to understand the process in detail, it is necessary to explore several sources;

– lack of a unified register of funeral organizations, as a result, the lack of an opportunity to compare services and the price range for them from different organizations;

– impact of the human factor on processes (for example, a physical document may be lost).

The simplified «AS IS» scheme is presented in Figure 1 below.

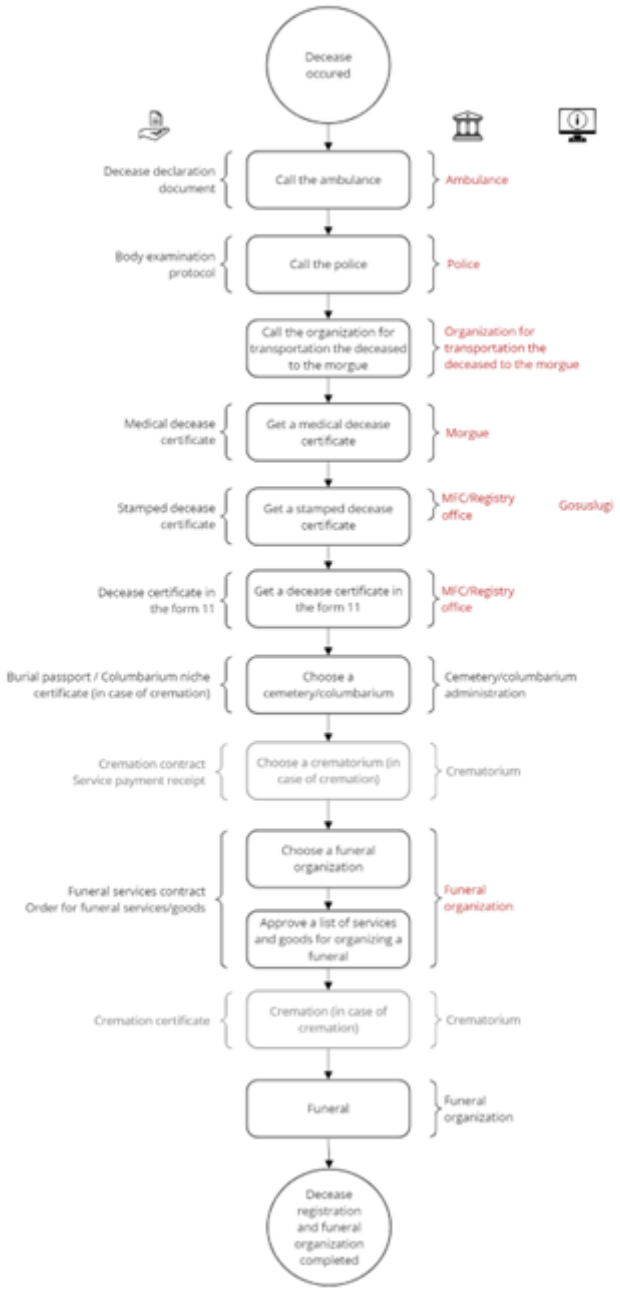


Fig. 1. Simplified «AS IS» scheme

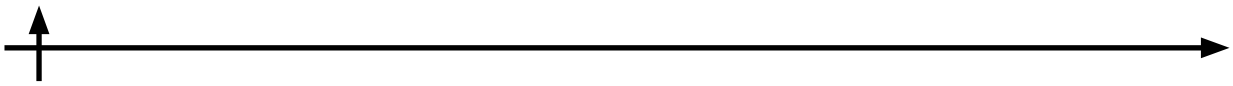
Based on the analysis of the register of Russian software, we can conclude that at the moment these are the information systems for digitalization processes in funeral and ritual activities (Federal information address system, nd.; Unified register of Russian computer programs, nd.):

– AeroGIS «Kladbishche» which is designed to conduct an inventory of cemeteries and keep records of burials;

– 1C:Enterprise 8. Ritual services management, which is designed to automate the activities of businesses that provide funeral services;

– GIS «Pamyat», which is designed to maintain electronic accounting in the field of burial and funeral services for municipal public institutions (GISPAM, nd.).

AeroGIS «Kladbishche» is a software designed for an cemeteries inventory and further ac-



counting of burials. The users of «AeroGIS Kladbishche» are state and municipal organizations working in the funeral and ritual area.

The system is designed for:

– building a system of modern electronic accounting and search for burial places;
– identification of burials;
– identification of empty places on the territory of the cemetery;
– identification of burials that exceed the standards of permissible fence sizes;
– improving the efficiency of municipal services provided to the population, generating documentation about the location of the grave;
– valuation of empty land and planning of cemeteries.

However, it is important to note that the system is provided free of charge, when ordering a set of services cemetery inventory. The system cannot be bought separately. The system is adapted for large-scale maps, has a built-in ruler, allows to maintain a database of burials.

1C: Ritual services management – industry solution, which is designed to automate management and operational accounting for businesses in the funeral industry: funeral organizations, cemeteries and other businesses that provide funeral services. «Ritual service's management» configuration is based on a typical configuration of «Management of our company» of software system «1C:Enterprise 8» with preservation of all the features and mechanisms of the standard solution.

1C: Ritual services management automates the following processes:

– receiving and accounting of orders from customers for ritual services;
– receiving orders for monuments and engraving work;
– receiving orders for the care of the burial places;
– production management;
– transport management;
– registration of burial places;
– record keeping, preparation and submission of individual entrepreneur reporting.

Geographic Information System «Pamyat» is software targeted at municipal institutions designed to maintain accounting in the field of funeral services. The software is included in the unified register of Russian programs for electronic computers and databases of the Ministry of Communications of the Russian Federation and can be freely purchased by municipal institutions in accordance with the Federal Law N44-FZ (Federal law N 44-FZ from 05.04.2013). There are two versions of the system – desktop and web version.

Due to the tightening of legislation, executive authorities, as government contracting authority, need to justify and calculate the price of a state order. One of the ways to calculate the maximum procurement price is the method of comparing market prices (or market analysis method), which involves establishing the maximum procurement cost based on information on market prices for identical goods, services or works planned for procurement. Information on market prices is based on commercial proposals received by contracting authority's request from the executing companies. Moreover, the executing company have to explain the source of the commercial proposal positions.

As an example, this research provides a commercial proposal from development company, which, together with other proposals, forms the basis for justifying the maximum procurement price based on the market analysis method. In order to calculate development costs, it is necessary to determine which human resources are involved in the project, calculate the cost per hour of work for each employee, and based on the data obtained, build a summary table that will display the cost of work for each stage.

The following human resources are involved in the Unified system of funeral and ritual ser-

vices creation project:

1. development team:
- 1 senior back-end developer;
- 2 middle back-end developers;
- 1 senior front-end developer;
- 2 middle front-end developers;
- 2 test engineers;
- 1 system administrator;

2. analyst team and project manager:
- 1 middle business analyst;
- 1 middle system analyst;
- 1 senior analyst;
- 1 project manager;

3. technical writing team:
- 1 senior technical writer;
- 1 middle technical writer.

All of the above employees are employees of the development company that is creating the Unified system of funeral and ritual services. The results of calculating the cost per hour for each employee are presented in Table 2.

Table 2. The cost per hour for each employee

Employee	Cost per hour, rub
Senior back-end developer	1640
Senior front-end developer	1518
Project manager	1336
Senior analyst	1215
Middle back-end developer	1154
Middle business analyst	850
Middle system analyst	789
Test engineer	668
Senior technical writer	668
System administrator	547
Middle technical writer	486

Department employees are also involved in the project, who are participating in the initiation of the project, formation of requirements, development of concept, technical specifications, and technical project, conducting preliminary complex tests of the system and system trial operation, as well as system acceptance tests. However, their work is not additionally paid, as it falls within their competence.

Based on data on human resources, cost per person-hour, time spent on the development and implementation, and the scope of work, it is possible to create a table with the cost of each project operation. Table 3 shows the cost for each stage of the project. The result of the calculations is the total cost of the development and implementation of the Unified system of funeral and ritual services.

Table 3. Costs of project stages

№	Stage name	Cost of the work of employees during the stage, rub
1	Project initiation	0
2	Formation of requirements	0
3	Concept development	0
4	Technical specification	0
5	Technical project	335 200
6	Software and documentation development	12 607 080
6.1	System software development	12 451 640
6.2	Development of documentation for the system	155 440
7	Commissioning	661 304
7.1	Preparation of the automation object for the commissioning of the system	75 320
7.3	Installation of cryptographic tools of the system	75 320
7.4	Staff training	80 160
7.5	Preliminary complex tests of the system	93 288
7.6	Preliminary autonomous tests of the system	93 288
7.7	System trial operation	0
7.8	System acceptance tests	93 288
TOTAL		13 603 584

Based on the calculations conducted, it can be concluded that the cost of developing and implementing of the Unified system of funeral and ritual services is 13 603 584 rubles.

In this project the cost of software is equal to the cost of the CryptoPro CSP 5.0 license, i.e., 200 000 rubles. There are no other software costs since the Unified system of funeral and ritual services is being developed from scratch by the development company using previous project experience. In government organizations (call centers, client centers) of the region, where the Unified system of funeral and ritual services will be implemented, all workstations of employees who will be using the system are equipped with necessary equipment (PCs and related components). It is planned that 70 employees will use the system. However, it is necessary to purchase and install servers for the system to function. The necessary equipment purchases are shown in Table 4.

Table 4. Equipment costs

Equipment type	Quantity, pcs.	Cost per piece, rub.	Cost, rub.
Server	2	459 000	918 000
Cable set	2	3000	6000
TOTAL			924 000

Thus, equipment costs are 924 000 rubles.

After calculating the development and implementation costs, as well as software and equipment costs, capital expenditures were calculated. The capital expenditures of the project are presented in Table 5. The data for the table creation were taken from Tables 3 and 4.

Table 5. Capital expenditures

Capital expenditures type	Cost, rub.
Development and implementation costs	13 603 584
CryptoPro CSP 5.0 license cost	200 000
Equipment costs	924 000
TOTAL	14 727 584

Based on the calculations, it can be concluded that the capital (investment) expenditures of the creating the Unified system of funeral and ritual services project are 14 727 584 rubles. After calculating the capital costs, operational costs were calculated. The calculations are presented in Table 12. It should be noted that the government organizations (call centers, client centers) of the region, where the Unified system of funeral and ritual services will be implemented, equipped with the 70 PCs (since the planned number of system users is 70 employees, 70 PCs are taken into account) and their components (computer mice, keyboards). There are also some general rules for depreciation calculation in government organizations:

– depreciation is calculated based on depreciation rates for fixed assets worth over 100 000 rubles;

– depreciation is not calculated for fixed assets worth less than 10 000 rubles;

– for fixed assets worth from 10 000 to 100 000 rubles, depreciation is the amount of 100% of the initial cost.

Table 6. Operational costs

№	Indicator	After implementation, rub./month	Note
1	System maintenance costs	417 700	System maintenance includes: – system health monitoring; – system backup; – consulting of IS users; – technical support.
2	Costs for maintenance of equipment (PCs, PC components, servers, and server components)	42 680	The government organizations (call centers, client centers) of the region, where the Unified system of funeral and ritual services will be implemented, equipped with the 70 PCs and PC components. Servers and server components were purchased for the system implementation. The costs per unit are as follows: – 524 rubles/month for a PC; – 2000 rubles/month for a server; – 500 rubles/month for server components; – 1000 rubles/month for PC components.
3	Depreciation expenses	79 714.25	As mentioned before, the government organizations (call centers, client centers) of the region, where the Unified system of funeral and ritual services will be implemented, equipped with the 70 PCs and PC components. The monthly depreciation expense for the PCs is 0 rubles (since each PC cost 41 000 rubles, government organizations apply 100% depreciation to fixed assets worth from 10 000 to 100 000 rubles when put it into operation). The monthly depreciation expense for the servers is 79 714.25 rubles (each server cost 459 000 rubles, and government organizations apply depreciation according to the calculated depreciation rates (33.33% of the initial cost) for fixed assets worth over 100 000 rubles). The depreciation expense for the components of PCs and servers was not calculated (the initial cost of a computer mouse and keyboard set is 1 750 rubles, and the components for the server are 3.000 rubles).
	TOTAL	540 094.25	

Based on Table 6, it can be concluded that the operational costs after implementing the Unified system of funeral and ritual services will be 540 094.25 rubles per month.

Conclusions

The implementation of information technologies in funeral and ritual activities will provide many opportunities for the development of this field. Digitalization in this area will provide a unified information environment for appeal about the decease fact processing, interaction between various organizations involved in funeral activities, as well as transparency and efficiency of the management and workflow processes when registering a decease and organizing a funeral. Also, due to the creation of the information system, a greater number of actions to be performed during the decease registering and organization of the funeral is IT-supported.

Nowadays, complex automation systems for funeral and ritual activities are not created and used in the almost regions of the Russian Federation, so it is necessary to create, develop, and improve digital methods to support decease registering and funeral organization in the regions. The solutions observed in this research prove to be highly economically efficient.

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IMPROVEMENT OF THE SYSTEM OF WORKING WITH SUPPLIERS AT ENTERPRISES OF THE POWER ENGINEERING SECTOR

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Abstract. Building a successful procurement cycle is not only related to the internal needs of the organization, but also to the external environment of the enterprise. Ensuring the internal needs of the enterprise in procurement directly depends on correctly selected suppliers that would meet the necessary procurement criteria and the stated requirements for purchased materials. This article considers the process of improving the system of work with suppliers at the enterprises of power machine-building complex. In the course of the research the main classifications of suppliers were considered and typical problems in the organization of interaction with them were revealed. Based on the obtained data, the most effective algorithm for selecting suppliers has been developed, and a set of measures to improve their activities in cooperation with enterprises of the power engineering sector has been proposed.

Keywords: power engineering company, suppliers, procurement, procurement, strategic materials, procurement processes

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СОВЕРШЕНСТВОВАНИЕ СИСТЕМЫ РАБОТЫ С ПОСТАВЩИКАМИ НА ПРЕДПРИЯТИЯХ ЭНЕРГОМАШИНОСТРОИТЕЛЬНОГО СЕКТОРА

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Аннотация. Построение успешного закупочного цикла связано не только с внутренними потребностями организации, но и с внешней средой предприятия. Обеспечение внутренних потребностей предприятия в закупках напрямую зависит от верно выбранных поставщиков, которые отвечали бы необходимым критериям закупок и заявленным требованиям к закупаемым материалам. В данной статье рассматривается процесс совершенствования системы работы с поставщиками на предприятиях энергомашиностроительного комплекса. В ходе исследования были рассмотрены основные классификации поставщиков, а также выявлены типичные проблемы в организации взаимодействия с ними. На основании полученных данных был разработан наиболее эффективный алгоритм отбора поставщиков, а также предложен комплекс мер по совершенствованию их деятельности при сотрудничестве с предприятиями энергомашиностроительного сектора.

Ключевые слова: энергомашиностроительная компания, поставщики, закупки, стратегические материалы, процессы закупочной деятельности

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Introduction

The procurement management process is not only a tool of procurement logistics, one of the activities of the company, but also a significant aspect for the realization of the enterprise's activities, especially if the company is a manufacturer. First of all, effectively built mechanisms of management of purchased items allow to ensure uninterrupted operation of the production cycle by purchasing on favorable conditions for the enterprise, requiring prompt and high-quality deliveries. Secondly, saving on purchases, ensuring guaranteed and uninterrupted supplies directly affects the final financial results of the company's activity.

A wide choice of potential suppliers of components increases the relevance of the problem of selecting those suppliers who would be able to ensure reliability and quality of the procurement process with the greatest effect. The limited choice of suppliers, on the other hand, requires a thorough search for reliable suppliers (Ivashov, 2015).

At the moment, selecting a supplier only on the basis of optimal prices is not enough for successful procurement management. It is necessary to expand the scope of supplier performance evaluation, improve interaction with suppliers in order to achieve optimal and mutually beneficial conditions. It is also necessary to apply its supplier management mechanisms based on the performance evaluation of the materials purchased from them. If the method of working

with suppliers and the materials purchased is not correct or not sufficiently correct, difficulties may arise in the procurement process, which affects the overall functioning of the enterprise.

Materials and Methods

The methodological basis of this research rests on collection and analysis of information, comparison, description, classification and generalization. Procurement activities were thoroughly analizaed by the authors on the basis of significant research papers by A. M. Gadzhinsky, D. A. Ivanov, E. S. Yudnikova, E. I. Arashkevich, V. M. Makarov, G. M. Greiz, P. Kralich, B. A. Anikin, O. S. Zhuravleva, etc.

Results and Discussion

Today, there are a large number of suppliers, so the main task is to choose a supplier that will be a reliable partner for the company and the best option for procurement.

There are different classifications of suppliers. One of the classifications, depending on the materials supplied, distinguishes suppliers of non-critical, basic, problematic and strategic materials. This classification of suppliers is based on the Kraljic matrix, where the main classification parameters are the impact on profit and supply risk (Gadzhinsky, 2017).

These suppliers also have their own procurement management and supplier relationship strategies:

1. basic materials. The category of basic materials is considered to be one of the most profitable for the company. The probability of supply disruption is low, and the number of suppliers is sufficient to find a replacement. In this variant the strategy of interaction with suppliers is manifested in tenders and market bidding in order to minimize procurement costs and select the most preferable supplier among their large number.

2. Strategic Materials. This type of materials has a high value and is critical for the functioning of the enterprise due to the lack of substitutes. Close relationships must be built in the interaction with suppliers. The relationship focuses on long-term cooperation and strategic alliances. Early stage suppliers are preferentially selected and involved.

3. non-critical materials. This category is procured in order to ensure the effective functioning of the enterprise. According to the matrix, these goods are not in short supply, their supply is always up-to-date and does not cause difficulties in purchasing. Accordingly, the strategy of work with suppliers is aimed at reducing the time and costs of logistics processes.

4. Problem materials. These goods have insignificant impact on the company, however, when purchasing materials whose production is limited due to the uniqueness of the technologies used, the risk of supply is high. Suppliers of these materials have more power and influence than the customer. For this reason, it is recommended to contract volume insurance and to implement an inventory management system by the supplier. Additionally, it is important to build up additional inventories.

The correct choice of suppliers directly affects the customer value of the goods produced or sold. At the moment, identifying a supplier only on the basis of optimal prices is no longer sufficient for successful procurement management.

Strategic sourcing, which is a process of finding, testing and involving suppliers of goods, is introduced into the sphere of interests of top management, for the reason that saving on purchases, ensuring guaranteed and uninterrupted supplies directly affects the final financial results of the company.

Considering the stages of procurement activities, including the steps to select the optimal and satisfying the needs of the enterprise supplier, the main points of the sub-process of supplier identification can be presented in the form of the following algorithm presented in Figure 1.

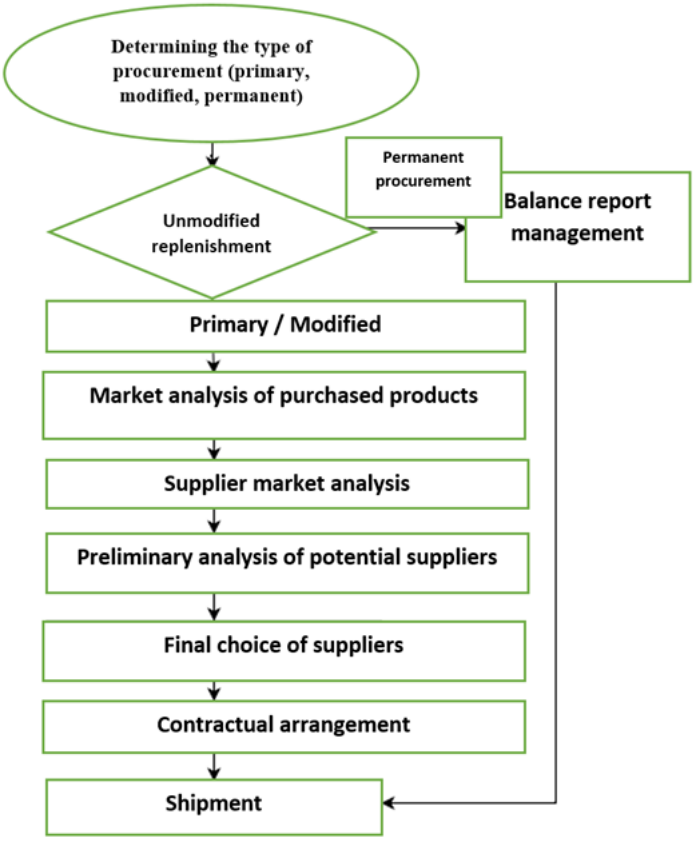


Fig. 1. Supplier selection algorithm

At the stages of preliminary evaluation of potential suppliers and final selection of suppliers, rating and expert evaluation methods are applied.

When applying the rating evaluation method, the criteria for evaluating suppliers in accordance with the objectives of the enterprise are identified. Then each evaluation indicator is assigned its own weight depending on its importance. It can be calculated by the method of expert evaluation.

For peer review, a group of experts is assembled and then their competence is assessed. For this purpose, managers assess the competencies of experts and calculate a square matrix of assessments Kij given by the i-th expert j-u according to formula 1:

$$k_i = \frac{\sum_{j=1}^{n} K_{ij}}{\sum_{j=1}^{n}\sum_{i=1}^{n} K_{ij}}, j = 1,2,...,n \quad (1)$$

where k_i – expert competence ratio;

$\sum_{j=1}^{n} K_{ij}$ – overall score of the jth (j=1, 2,...n) expert, obtained by the sum of all experts giving estimates (i=1, 2,...n);

$\sum_{j=1}^{n}\sum_{i=1}^{n} K_{ij}$ – sum of total assessments of evaluated experts (j=1, 2,...n);

n – number of experts.

At the next step, a list of criteria for evaluating suppliers is formed. Experts evaluate the factors of supplier selection, resulting in the formation of a matrix of dimension n*m, where the factors' significance coefficients are calculated according to formula 2:

$$f_j = \frac{\sum_{i=1}^{n} F_{ij} k_i}{\sum_{j=1}^{m} \sum_{i=1}^{n} F_{ij} k_i}, j = 1, 2, ..., m \quad (2)$$

where f_j – share coefficient of significance of the supplier evaluation criterion;

m – number of evaluated factors;

k_i – expert competence ratio;

$\sum_{i=1}^{n} F_{ij} k_i$ – the sum of the products of the expert's competence coefficient and the assessment given by all experts (i=1, 2,...n) jth factor;

$\sum_{j=1}^{m} \sum_{i=1}^{n} F_{ij} k_i$ – the sum of the products of the expert's competence coefficient and the assessment given by all experts (i=1, 2,...n) by all factors (j=1, 2,...m).

When calculating the coefficients of significance of factors, it is also necessary to observe the following condition presented in formula 3:

$$\sum_{j=1}^{m} f_j = 1 \quad (3)$$

where $\sum_{j=1}^{m} f_j$ – sum of weight coefficients of significance of supplier evaluation factors (j=1, 2,...,m).

After defining the supplier evaluation list with assigned importance weights, experts evaluate each supplier on a 100-point scale for each evaluation indicator.

The following criteria are used as frequently used evaluation indicators and the corresponding score calculation settings are applied to them.

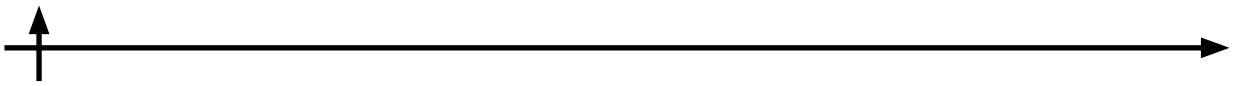
Based on the calculation of weighted scores, the final score of the supplier is determined, which takes values from 0 to 100 points, and the supplier is assigned to one of the categories: acceptable (from 60 to 100 points), conditionally acceptable (from 40 to 59) and unacceptable (from 0 to 39).

Finding and selecting the right supplier is one of the most important sub-processes of procurement activities. Keeping the sequence of determining the right supplier, taking into account the research, both marketing and commercial, minimizes the negative consequences of working with suppliers, and therefore reduces downtime in subsequent sub-processes of procurement activities and other activities at the enterprise (Demin, 2015).

In accordance with the needs of the company and the application of the Kraljic matrix, a certain supplier management is built and mutually beneficial cooperation is developed. By classifying suppliers and ranking them based on their strategic importance for the company, it is possible to optimize procurement costs by reducing the number of non-critical suppliers or directing efforts to find strategically important suppliers. Having determined the requirements for suppliers, having studied their activities, it is necessary to evaluate them according to the list of importance criteria. This step will allow a more accurate selection of suppliers (Mishchenko, 2011).

Thus, working with suppliers is of key importance for effective procurement management and the overall running of the company. Decisions made at this stage directly affect subsequent operations in the procurement process. With the right decision, there are no difficulties and risks in the sub-processes of order formation and order fulfillment control, which means the successful implementation of the complete procurement process.

In its turn, efficient execution of the procurement process optimizes further processes at the production enterprise, eliminating the risks of production and sales downtime in case of unsuccessful supplier selection and subsequent difficulties.



For the greatest representativeness of the above statement, let us consider the main principles and stages of work with suppliers at the enterprise of JSC Power Machines.

Work with suppliers at the enterprise is formed according to the category strategy in accordance with the standards approved by JSC Power Machines (hereinafter - STO): "Procedure for Procurement Activities" and "Procedure for Supplier Audits".

The general areas of work with suppliers can be summarized as the following activities:

1. Carrying out competitive purchases in order to find new suppliers;
2. Carrying out purchases from a single source;
3. Simplified procurement with invitations to participate;
4. evaluation of new suppliers;
5. Quarterly evaluation of existing suppliers;
6. Supplier audits.

As any commercial organization, JSC Power Machines selects suppliers on the basis of competitive procurement. According to the Federal Law "On Procurement of Goods, Works, Services by Certain Types of Legal Entities" dated 18.07.2011 N 223-FZ competitive purchases are carried out (Shumaev, 2016):

1) by bidding through:

– tender: open, in electronic form, closed;
– auction: open, in electronic form, closed;
– request for quotations: in electronic form, closed;
– request for proposals: in electronic form, closed;

2) by other means meeting the following requirements:

– information about the competitive procurement is communicated through a unified information system or by sending invitations to participate in a closed competitive procurement;
– competition between participants of competitive procurement is provided (Makarov, 2008).

1. Competitive procurement. This type of procurement is conducted on electronic trading platforms (ETP), including ETP NEP-Fabrikant, where inventory is procured, and ETP TEK-Torg, where procurements for the provision of necessary services and works are placed for companies of the fuel and energy complex of the Russian Federation and companies with state participation, including JSC Power Machines (Buzukova, 2015).

Upon receipt by the Procurement Directorate of route-material specifications (hereinafter - MMC) or technical specifications containing the most complete information about the planned for purchase of the goods and materials, its nomenclature number, including the regulatory document under which the goods and materials are purchased, a request (application) for the purchase of certain goods and materials is formed on the ETP, specifying the name of the item, lot category, delivery volume, number of lots and terms of procurement. It is also possible to specify the project under which the products are purchased (Grekul, 2012).

To participate in the tender, suppliers with whom work has been done before, suppliers recommended or decided by the Applicant are invited. Further, suppliers interested in participation submit a technical and commercial proposal (hereinafter - TKP) for consideration. During the review of the TQP a re-bidding takes place - a part of procurement activities to improve the conditions of interaction between the two parties: the customer and the bidder (Greiz).

After the review and selection of the supplier, a protocol for selecting the winner of the electronic tender is formed, after which it is submitted to the Procurement Department, where contractual relations with suppliers are concluded. After the contract is concluded, the delivery is monitored until its completion and settlement with suppliers.

2. Procurement from a single source. According to this type of procurement is carried out from one company producing unique products or having a normative document, which belongs

only to the selected company for the production of goods and materials. In accordance with the selected supplier, the design bureau draws up a conclusion, according to which the procurement of materials and equipment is carried out from a single supplier without going out to bidding with competitive procurement, since taking into account the specification of the purchased products, analogues are not considered (Ivanov, 2009).

3. Simplified procurement. This type of procurement is a purchase of up to 500 thousand rubles. In this procedure, no bids are placed on ETP. The manager of the procurement department sends a request to suppliers and receives at least three TKP from suppliers. After that, the supplier is selected and the protocol for selecting the winner is formed. Also in this situation it is possible to carry out procurement from a single source.

4. Evaluation of new suppliers is carried out according to the questionnaire filled in by the supplier. A familiarization audit is also conducted.

5. Evaluation of existing suppliers. After contractual relations with a new supplier are formalized, each supplier is entered into a database, where all suppliers are controlled according to certain parameters and assigned their ratings. Among the most important evaluation criteria are: term, price, quality. In the first place the term of delivery is determined taking into account the current situation on the market of imported components, the price and quality are equally evaluated (Anikin, 2013; Ilin, 2022).

6. Audit of suppliers is carried out in accordance with STO "Procedure for audits of suppliers". Audits may be conducted in accordance with the annual audit plan, unscheduled, on-site or desk audits. The group of auditors is formed by the Director of the Quality Directorate with the invitation of technical experts and appointment of the person responsible for the audit - the head of the audit. The result of the audit is formed in the audit report, which presents an objective assessment of the supplier.

Analyzing the formats of supplier selection at the enterprise under consideration, it can be noted that the process of supplier selection complies with the legislation of the Russian Federation, namely the Federal Law "On the procurement of goods, works, services by certain types of legal entities" from 18.07.2011 N 223-FZ. Thus, the work with suppliers complies with the competitive and equitable principles of participation in tenders.

Realization of ABC-analysis in this enterprise is a reasonable measure, as the main purpose of ABC-analysis in procurement logistics is to reduce the value of stocks (Kralich, nd.).

There are 14 categories in the assortment of purchased by the enterprise, each of which is divided into its subcategories.

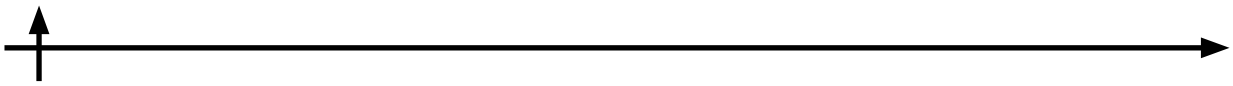
Accordingly, for each subcategory it is necessary to carry out an appropriate analysis due to the fact that the purchased goods are diverse and require separate attention to each item.

The idea of ABC-analysis is to select the most significant objects of the assortment from the whole set of homogeneous objects from the point of view of the purpose of the analysis.

Since in Section 3 we considered the procurement activities for the purchase of materials of Category No. 3 "Metal Rolled Products", ABC-analysis will be conducted in the context of purchased commodities of this category.

Category #3 includes the following subcategories of procured commodities:

- flat rolled products,
- long products,
- packaged rolled products,
- tubular rolled products,
- rolled non-ferrous metals,
- precious metals.



The algorithm of work on ABC-analysis is proposed to be carried out in the following order:

Step 1: Formulation of the analysis objective. Depending on the purpose of the analysis: reduction of the inventory value, reduction of the number of movements in the warehouse, reduction of thefts of material assets, - there will be chosen their own criteria of the analysis, on the basis of which the categories of inventory will be ranked and their management will be built. Therefore, at the beginning it is necessary to designate the purpose of the analysis.

In our case, the purpose of the analysis is to reduce the size of inventories, namely, low-maintenance inventories (LMOs).

Step 2: Identification of analyzed objects of ABC-analysis. In order to reduce the amount of stocks not only the items of the purchased nomenclature can be analyzed, but also the sources of their occurrence, for example, suppliers. In this case of analysis attention is paid to the work with suppliers in order to reduce the goods in the warehouses received from this supplier.

In this research, the objects of study are nomenclature items of Category #3 "Metal Rolled Products" received from the respective suppliers.

Step 3: Determination of the feature on the basis of which the classification of management objects is carried out. Setting the goal of reducing the stock in the warehouse, it is necessary to classify the assortment, which share takes the largest amount of cash. It is also necessary to analyze the turnover of these items for the time period that it is in the warehouse. And the third important criterion is the volume of ordered commodities. The categories obtained during the analysis will reflect the items as multi-day inventories, which are expensive to maintain (Ivashov, 2015).

This three-factor analysis: by the cost of purchased goods, turnover and volume of deliveries (purchases) will give a full-fledged analysis of inventory, which will identify items, orders for which should be taken under strict control, as well as to build a scheme of work with suppliers whose goods fall into critical categories of purchases.

Step 4: Evaluation of objects according to the selected classification criterion. The results of each item in descending order are recorded by the allocated criterion.

Thus, by cost the assessment is formed by descending value of each item; by turnover - by descending volume used per day; by delivery volume - by descending size of deliveries.

Step 5: Grouping of management objects in descending order of the feature value. Next, the shares of realization of each item in the total result of the criterion in descending order are calculated for the allocated criterion. Then for each item the share of realization in the total realization calculated by cumulative total is calculated.

Step 6: Construction of ABC curve. After the calculated shares by cumulative total it is necessary to build the ABC curve, where on the OX axis the shares of the position in the total nomenclature list are put off, and on the OY axis - the share of realization of the position expressed by cumulative total. Since a total of 50 items of commodities are analyzed, each point (the position of commodities in the nomenclature) on the axis OX is put off in increments of 2%, since the total sum is equal to 100%.

Step 7: Division of the set of objects into three groups: group A, group B, group C. The usual division of groups in ABC-analysis is based on Pareto's law, where 20% of investments give 80% of the result, which in most cases is not suitable for the division of nomenclature items.

Conclusion

The problem of supplier selection and evaluation is one of the most important in procurement, which can be seen in the decomposition of this process, where the selection and evaluation of suppliers occupy a crucial place. Every organization should improve its competitiveness and reduce the costs of procurement activities, which will be helped by selecting the most

appropriate supplier evaluation and selection system. In order to successfully select the most appropriate selection system, it is necessary to rely on the rating method as well as the method of expert evaluations. Based on the proposed algorithm for selection and evaluation of suppliers, it is possible to visualize the functionality of procurement activities, to define the role of the supplier in procurement logistics, to describe the stages of procurement, as well as the tools used at each stage.

Further research in the field of supplier selection at the enterprises of power machine-building complex is recommended from the point of view of adapting the method of ABC-analysis, expert-rating assessments, as well as building a decision tree.

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IMPROVING THE EFFICIENCY OF DRUG SUPPLY MANAGEMENT OF A MEDICAL ORGANIZATION THROUGH THE USE OF A BUSINESS INTELLIGENCE SYSTEM

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Abstract. This paper considers the process of drug management in a medical organization providing medical care under the MHI, on a fee-for-service basis, as well as high-tech medical care. The provision of medicines is one of the most complex multilevel tasks that medical organizations have to deal with. In the course of the study the potential importance of improving the manageability of medicines based on data for the medical institution and the healthcare industry as a whole was determined, the existing shortcomings of the medicines management process were identified and the BI-application model that solves the various problems that arise during the management of medicines was created. Practical significance of the work is due to the results of the performance evaluation: the use of the model will allow to visualize complex medical data, contributing to improving the quality of services, transparency of quantitative and financial costs of medicines and obtaining important statistical data for healthcare.

Keywords: medication management, Smart Hospital, BI applications, Data Driven, business modeling

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ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ УПРАВЛНЕНИЯ ЛЕКАРСТВЕННЫМ ОБЕСПЕЧЕНИЕМ МЕДИЦИНСКОЙ ОРГАНИЗАЦИИ В ХОДЕ ПРИМЕНЕНИЯ СИСТЕМЫ БИЗНЕС-АНАЛИТИКИ

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Аннотация. В данной статье рассматривается процесс управления лекарственным обеспечением в медицинской организации, оказывающей медицинскую помощь в рамках ДМС на платной основе, а также высокотехнологичную медицинскую помощь. Лекарственное обеспечение является одной из наиболее сложных многоуровневых задач, стоящих перед медицинскими организациями. В ходе исследования была определена потенциальная значимость повышения управляемости лекарственным обеспечением на основе данных для медицинского учреждения и отрасли здравоохранения в целом, выявлены существующие недостатки процесса управления лекарственным обеспечением и создана модель BI-приложения, решающая различные проблемы, возникающие при управлении лекарственным обеспечением. Практическая значимость работы обусловлена результатами оценки эффективности: использование модели позволит визуализировать сложные медицинские данные, способствуя повышению качества обслуживания, прозрачности количественных и финансовых затрат на лекарственные средства и получению важных для здравоохранения статистических данных.

Ключевые слова: управление лекарственными средствами, Smart Hospital, BI-приложения, Data Driven, бизнес-моделирование

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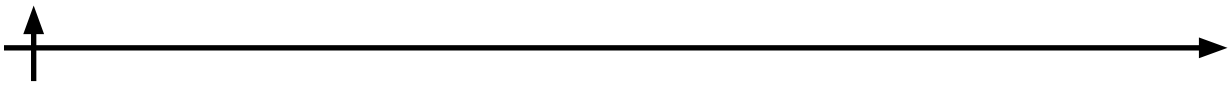
Introduction

The proliferation of increasingly sophisticated technologies makes human life more comfortable in many different areas. Smart solutions are spreading everywhere: neural networks, Internet of Things, tracking of various indicators, for example, driving style. Similar "smart" technologies are also present in medicine, directly influencing not only convenience but also people's lives through the use of modern digital equipment and an innovative approach to treatment.

The innovative approach to treatment should also include the process of medication management. The provision of medicines is one of the most complex multi-level challenges that healthcare organisations have to face. The solution of this task is presented by various methods, but it is extremely difficult to develop a single organisation of this process due to the different focus, level of development, workload and organisation of work of medical organisations in general and clinics in particular (Melnikova, 2019).

The object of the study is the process of managing the drug supply of a medical organisation, the subject is to improve the efficiency of this process in the application of business intelligence



system (Ilyashenko, 2020).

The aim of the work is to create a model of BI-application capable of giving doctors and analysts access to important non-obvious information obtained during the application of medicinal treatment of patients (Anufrieva, 2022). The objectives of the work are to:

1. to determine the potential value of improving data-driven medication management for both the healthcare provider and the healthcare industry as a whole;

2. to dentify the existing deficiencies in the medication management process;

3. to create a valid BI application model demonstrating the potential effectiveness of the solution.

Materials and Methods

Therefore, it is essential not only to manage medicines, but also to use modern smart solutions in this process to achieve qualitatively new results in various fields, in particular, in medicine. Medical organisations that use the Smart Hospital concept in their development and aspire to become an institution that can rightfully be called a Smart Hospital, naturally seek to use innovations in their processes to improve their efficiency. These efforts often result in cost savings, staff relief, fewer errors, and critical data that can be used to create predictive analytics that monitor and forecast processes (Bouvy, 2021), thereby improving the accuracy of results for all processes being evaluated, gaining new insights through in-depth analyses of seemingly unrelated facts and events, and increasing process transparency, which reduces misconduct by increasing the number of errors and errors in processes. All of the above can not only provide localised improvements, but, in the case of the medical sphere, it has a positive effect on the quality of treatment as a whole, which, in turn, is one of the main objectives of healthcare.

The described effects are largely based on data and the correct construction of work with them. Special attention should be paid to BI-systems - tools that use advanced methods to collect, analyse and present data, including in large volumes, to extract meaningful information for the purpose of making management decisions. In healthcare, BI systems can help hospitals and clinics make data-driven decisions that improve patient outcomes, reduce costs and increase operational efficiency. One of the key benefits of BI systems is their ability to combine data from multiple sources, including electronic medical records, pharmacy and accounting systems, into a single centralised repository, process it quickly and efficiently, and present this information in an easy-to-understand way that simplifies decision-making (Popova, 2020).

In the context of medication management, BI systems can help healthcare organisations optimise medication use and reduce medication errors. By analysing prescribing patterns and patient data, BI systems can identify potential drug interactions, dosage discrepancies and other issues that could compromise patient safety. They can also provide real-time data on medication use, allowing healthcare providers to quickly adjust dosages, change medications or take other actions as needed. In addition, BI systems can help healthcare organisations track drug stock levels and usage patterns, ensuring that medicines are available when needed and that waste is minimised.

Another benefit of BI systems is that they can help identify trends and forecast the need for medicines, allowing for optimised procurement and distribution (Litvinenko, 2021). It can also be useful for epidemic control, for example, when disease outbreaks occur, BI systems can help identify them quickly and take action to prevent and treat them. As the healthcare industry continues to become more data-driven (Rukina, 2022), BI systems can significantly improve the efficiency of medication management and improve the quality of patient care in healthcare facilities.

The organisation whose processes were used to analyse and create the BI application is the

Almazov National Medical Centre, which is a large scientific and medical institution in the Russian Federation and St. Petersburg that provides medical care under the MHI, on a fee-for-service basis, as well as high-tech medical care (Bansal, 2013; Ilin et al., 2019).

The uniqueness of the Centre lies in the harmonious combination of fundamental and applied research in various fields with the provision of multidisciplinary specialised, including high-tech medical care to the population and continuous interdisciplinary training of scientific and medical personnel.

The medical research centre has built a comprehensive system for planning the procurement of medicines and medical consumables and for monitoring their use at all levels of circulation. Attempts are being made to organise records of medicines and medical consumables by source of funding for procurement, as well as product records (by series and by batch) to monitor expiry dates and purchase prices. The Centre's management hopes to obtain full information in real time on the availability and consumption of medicines at any level, both in the warehouses and in the wards. For high-cost medicines and medical consumables, write-off information, within an idealised situation, should be detailed to the individual patient.

Let us consider the process of medicines management in the current state. Since the medical organisation is focused on the provision of high-tech care, it is expected to pay much attention to the optimization of processes taking into account modern approaches (Domracheva, 2017). The process of medicines management, which is supported by the Medical Information System (MIS) and the system of planning and accounting of medicines based on the industry solution "1C: Medicine. Hospital Pharmacy".

However, at this stage there is no IT support for medication management at the patient level, there is no tight mutual integration between the existing systems, and there are various problems of application utilisation by the staff (SHmonin, 2017). In particular, due to high workloads, staff do not have time to complete patient prescribing information, as this step of the application is not optimised for the needs of facility staff. For example, some data is extremely difficult to edit, so it is easier for staff to enter information into the system after a certain stage of treatment has been completed. Also, due to the complexities of working with the system itself, some data are recorded in paper spreadsheets, which is a consequence and supports the thesis about the complexity of interaction between systems and staff.

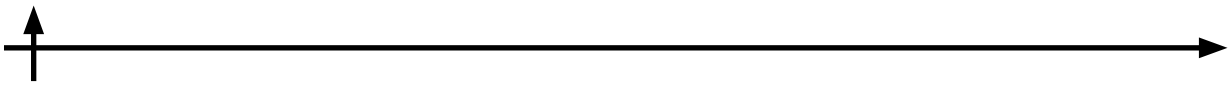
Thus, medication management is not fully supported, resulting in the following consequences:

1. the lack of a unified medication record at the level of the whole clinic and not always correct distribution of medication between departments and, eventually, patients;

2. complication of both current and predictive analytics in terms of finance (including determination of the level of costs per patient) and direct consumption;

3. the inability to collect meaningful medical statistics that can not only support the process, but also take into account the interrelationship of symptoms and predict the course of diseases, which in the long term could help to optimise treatment as well as improve the whole process of care.

As follows from the above, an important aspect of working with data is the process of data processing and analysis. BI-systems contribute significantly to solving this issue. Business Intelligence (business analytics, business "intelligence") has many interpretations that differ from each other to a greater or lesser extent (Ilin, 2021). This was due to the multifaceted nature of the word "Intelligence", containing such facets as the ability to be ready to understand, knowledge imparted or acquired in various ways, the process of knowing in terms of action or state and working with data in the field of their "exploration", study, research.A BI system technology that can have a significant effect on the process under consideration is the introduction of



dashboards, which serve as a visualisation system for operational management and comprehensive coverage of drug management. Visualisation is the representation of data using graphics such as charts, tables, graphs, graphs, infographics, animations, conveying complex data relationships in a way that is easier to understand. Dashboard is an interactive dashboard that visually presents, visualises, explains and analyses data.

Based on the existing difference in the medication management process between the current state and the optimised model, a way to modernise the process by implementing a BI class solution is being considered. Through such a step, tasks such as:

1. creating a single medication record at the clinic-wide level;

2. current and predictive analytics, taking into account the aspects of financing and consumption;

3. collection of full-fledged medical statistics serving as a basis for analysing costs and prospects of various methods of treatment of patients.

Thus, the following effects can be achieved:

– Ensuring control over the movement of medicines at all levels;

– Improving the efficiency of planning and implementation of drug procurement;

– Reducing the cost of procurement of medicines by increasing the accuracy of the formation of needs;

– Improved quality of customer service through accurate distribution of medicines between departments and patients;

– Reducing errors in the administration and recording of medication administration;

– Improvement of company image;

– Improved quality of service.

Expected damages (problems) should also be emphasised:

– Unpreparedness of personnel to change;

– Change in the technology of working with information;

– Temporary increase in the workload of the company's employees at some stages of the implementation project;

– System maintenance.

Consequently, the BI-system can be used to display the costs of medicines in quantitative and cost terms up to the costs per patient, the consumption of specific medicines at different levels of consumption in different time periods, as well as to display the methods by which symptoms were treated with which medicines. Accordingly, the analytical dashboards created in the BI system will be able to answer the following questions based on the selected data:

1. "how much in quantitative and financial terms were medications spent on a particular patient?";

2. "which medications are used in relation to symptoms and diagnoses?";

3. "in what dosages is the medication used?" and many others.

Based on the available test dataset, further analyses will be built on information about 64 patients belonging to 24 wards, 6 posts and 2 departments of the clinic. Consideration of drug provision would then cover all levels of the clinic: patient, wards, posts, departments and the clinic as a whole. However, it should be borne in mind that the data in the test model is incomplete, and therefore not all the benefits of using BI systems can be demonstrated. Thus, on the basis of the generated data, the QlickView programme was used to create a dashboard model, with the help of which the possible analytical dashboards that facilitate decision-making in the management of medicines are visually displayed.

Let's take a closer look at the task of determining the financial costs of medicines per patient. Based on the question posed, it can be seen that objects reflecting financial costs, medicines and

patients are needed. To realise this task, first of all, we created a Simple table, which contains ID-patients, their surnames, first names and patronymics to increase the clarity of orientation during use. The ability to apply sorting to this table makes it easier to find the desired patient. In addition, the "Search" field directly allows you to find a specific patient by patient ID, last name, first name or middle name.

The next step is to create a pie chart, where the patient ID and Medication Name are used as dimensions. The order in which the measurements are specified is important because it affects the way the data is displayed. The parameter "Cost of treatment in conventional units" is selected as an expression. The described analytical panel is shown in Figure 1.

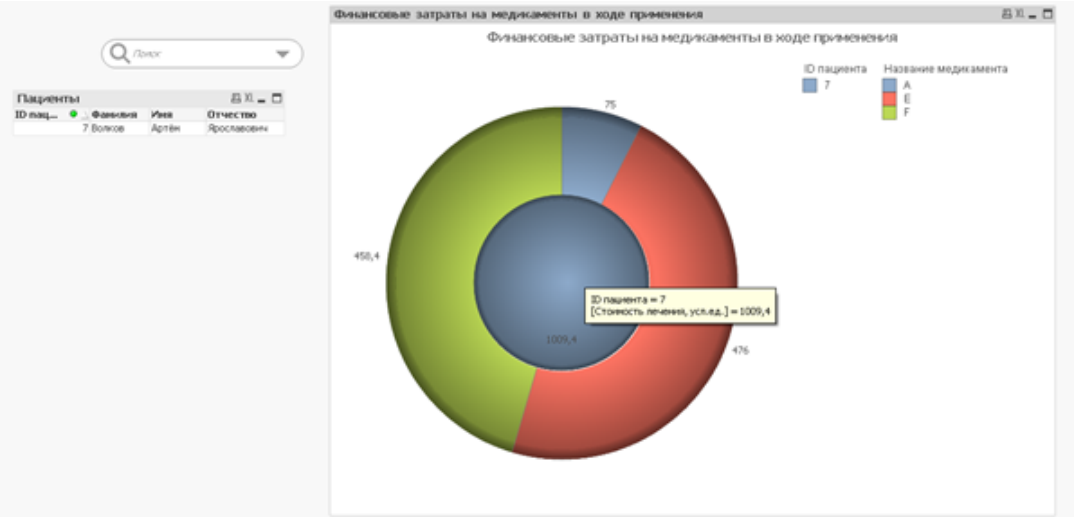


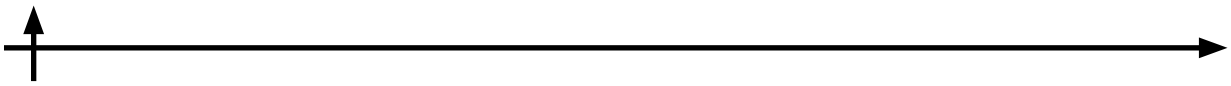
Fig. 1. How much financial resources were spent on medicines per patient

Thanks to the features of BI tools, it is possible to obtain specific illustrative values among a large amount of data. For example, if you move the cursor over the inner circle, you can see that the values represent the patient ID and the cost of treatment. The sector borders define the medications that were used during the treatment, and the triangle will indicate the selected ID in the list on the chart. If you select a patient ID from the list in the diagram, the sector related to it will be highlighted.

If you put the cursor over the outer circle of the diagram, the name of the medicament, the ID of the patient to which the sector with the medicament belongs, the cost of treatment with a specific medicament for a specific patient, as well as other sectors with the application of the medicament are displayed. The triangle in the side list displays the selected medication, and if you move the cursor over a medication from the list, the associated sectors in the diagram will be displayed.

If you click on a medicine from the list indicated in the diagram, a dip will occur, reflecting on which patients this medicine was spent on. At the same time, the content of the table showing the patient's name will change. The same process happens with all the data of the analytics application: only those that are relevant to the selected parameter are displayed.

The outer circle in this selection carries less visual analytical information, while hovering the cursor over one of the inner sectors reflects how much money was spent on the application of the selected medication for a particular patient. By selecting through search, filtering, ID, last name, first name, middle name or by clicking on the desired ID in the chart, the displayed data will change its appearance. By such selection and moving the cursor over the inner circle of the diagram, the answer to the initially posed question "How much money was spent on medicines



for one patient?" will be displayed: patient 7, cost 1009.4.

If you move the cursor over the outer circle, it will be displayed what costs for which medication were spent on a particular patient. It is also possible to sample a group of patients by selecting several patients in the list, which may be necessary for a clear comparative analysis. For example, if you move the cursor over the inner circle, you can see which medicines apply to the patient, the ratio of medicines to each other, and how much money was spent on the patient. If you move the cursor over the outer circle, you can see which patients in the group the medicine applies to, the name of the medicine and the cost of treatment with this medicine for the selected patient.

Results and Discussion

From the data presented, it is possible to draw conclusions about the financial costs that will be incurred in treating a patient with a particular data set. This makes it possible to predict the costs that may be incurred by both the clinic and the patient, and to determine what financial actions need to be taken and considered in order to achieve a positive effect from the treatment being carried out.

At the stage of solving the considered problem, it can be noticed that analytical dashboards are able to display the same data from different points of view, giving more possibilities for visualising the information when making management decisions. Thus, the use of even one dashboard can potentially provide an answer to a whole group of interrelated questions, which confirms the effectiveness of using BI-system as a tool for solving complex multifaceted problems (Koshechkin, 2018). This feature is also characteristic of the subsequent presented analytical dashboards.

Other tasks, the solution of which is possible with the help of BI-application, have been identified earlier and are presented further in a general way. For example, analysing how much medication was spent on a particular patient in quantitative terms. Such diagrams can help in analysing in what doses medicines are used at what characteristics of the patient, which can have a positive impact on treatment forecasting.

It is also important to analyse the use of medication in relation to symptoms and diagnoses. Using a BI application, an analytical dashboard has been created to show which medications and in what quantity were used when selecting a single symptom. When a particular medication is selected, the symptoms to which it applies and the frequency of use are reflected. In the case of this model, the display cannot be called capable of providing new analytical information, but it should be taken into account that in real data, medicines are often used against several different symptoms, which can make this display more statistically correct and weighty in analysing the use of medicines in treatment. When several medicines or symptoms are displayed, the chart shows how many times the medicines were used and against which symptoms, and in the second, which specific symptoms were used for which medicines and how many times they were used.

Based on these analyses, it is not only possible to determine the relationship between medicines and symptoms, but also to determine the frequency of use of medicines and to adjust procurement plans, leading to optimised drug costs. Similarly, analytics reflecting the association of medicines with diagnoses are presented in a similar way. By selecting one diagnosis, it is possible to obtain the entire list of medicines used during treatment, their names, their association with the diagnosis and the number of uses. When selecting several diagnoses in the form of columns of different colours, each of which characterises a diagnosis, the total number of uses and the specific relationship to the diagnosis will be available for each medicine used to treat the selected diagnoses. It is also possible to select a single medicine and obtain a single

column showing all diagnoses associated with the medicine and the frequency of use of the medicine for treatment. A similar display is possible when multiple medications are selected in relation to each medication. By applying this dashboard to analytics, it is possible to visualise the relationship between diagnoses and medications, which can have a positive impact on predicting the course of treatment when a patient is admitted and the cost of medications when dealing with a particular diagnosis.

The BI application also facilitates the display of the frequency of use of a medication. Thus, if a single medication is selected, it is displayed in which dosages it is used and with what frequency the dosage is used. When selecting multiple medicines, the display is similar: all dosages applicable to the medicines and the frequency of their use in the indicated dosages are shown. Making a selection by dosage displays which medicines have been used in the indicated dosages. Thus, this dashboard characterises the dosage of medication use, allowing the collection and evaluation of statistical data and, at the same time, predictive medication management in the clinic.

In addition to the previously mentioned tasks, the developed system makes it possible to obtain answers to such questions as: determination of the average duration of administration of different medicines, as well as financial and quantitative expenditure of medicines per department, post and ward. Thus, it becomes possible to compare drugs among themselves and determine the frequency of prescription of a particular term of administration, which can help to make a more correct prognosis of treatment with a particular drug. In turn, determining the distribution of medicines at different levels of the clinic down to the patient is useful both in terms of collecting statistics on the use of medicines and in tracking costs to avoid inappropriate write-offs, both in terms of financial and quantitative costs.

In addition to the above answers to these questions, the BI system can also be used to provide a comprehensive description of interrelated data on all parameters based on the choices made. Thanks to this feature, it becomes possible to obtain information that is not obvious at the first consideration, and at the same time - to draw new conclusions and even gain new knowledge.

In this application, not every dashboard reflects a lot of characteristics useful for analysis in the course of making a particular choice, however, based on all the above-mentioned features of the created analytics dashboards, we can conclude that the interconnection of dashboards created with the use of a single data model makes it possible to obtain indicative reliable information through simple actions, which is important for users who are not aware of the subtleties of such applications, but need their capabilities.

Conclusion

Based on the model work presented, the BI system collects data that is disparate and displayed in various tables, creating a clear, simple, and easy-to-use representation of the data. The ability to search, create lists of data and dive into different levels of information allows you to quickly gather information that answers a question in varying degrees of depth. The BI application's connectivity is worth mentioning: thanks to it, selecting a parameter on one panel changes the data displayed on the others, which makes the analysis more complete and in-depth. Thus, it becomes possible to quickly track changes in indicators, and, no less importantly, facilitates the process of detecting their connection even when it is not obvious. Thanks to this, the forecasting of drug costs, the impact of drugs, their applicability in certain cases and many other issues receive qualitative support based on data, which can improve the quality of medical services through the correct allocation of finances, resources (Chemeris, 2021), as well as the preliminary consideration of many indicators (Chemeris, 2022), which can suggest

a model of the most effective treatment.

In the course of applying the above model to real data, taking into account their supplementation with a wider set of interrelated tables, it should be expected that there will be an opportunity for rapid and high-quality analytics of processes related to medicines, which will have a significant positive impact on the entire process of medication management. The use of dashboards will make it possible to achieve an increase in the economic efficiency of the medical organisation through qualitative changes in its work. Thus, thanks to the use of analytical dashboards it is possible to:

1. more accurate forecasting of patients' treatment terms by taking into account the use of medicines depending on the patient's characteristics, which has a positive impact on the assessment of the state of the bed stock and planning of patient admissions;

2. Improving the accuracy of cost planning for the provision of medicines to the medical organisation and all its components up to the patient through the use of analytics of quantitative and financial use of drugs;

3. Increase transparency of medication use by tracking related indicators such as medication costs per department, post, ward and patient, which will allow to identify and exclude misuse and/or write-off of medications;

4. Obtaining data on medication use in relation to symptoms, diagnoses, timing of administration and patient characteristics that are important for overall health development, which will allow global patterns in population health to be noted and taken into account both in current planning and in the event of epidemics, emergencies, mass accidents and other factors affecting population health;

5. Increased patient satisfaction through the use of previously obtained analytical data in the course of treatment, which helps to predict the most appropriate method of drug administration (drugs, dosages, timing of administration) for a particular organism, taking into account its similarity with already studied cases;

6. Establishment of new standards of health care delivery to the population and development of innovations based on analysis and consideration of both explicit and implicit patterns of medication use and drug supply of the organisation.

It is expected that qualitative changes will also affect the quantitative indicators, having a direct impact on the flow of patients, namely by reducing the recovery time, due to which the total number of patients admitted per year will increase. This, in turn, will have a positive impact on the overall health of the community, which directly correlates with the goals of healthcare in general and the object of the study in particular, increasing the sustainability of the medical organisation.

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