

THE MINISTRY OF EDUCATION AND SCIENCE OF THE
REPUBLIC OF KAZAKHSTAN
Non-profit joint stock company
«ALMATY UNIVERSITY OF POWER ENGINEERING AND
TELECOMMUNICATIONS NAMED GUMARBEK DAUKEYEV»
Department of «IT engineering»

«APPROVED FOR PROTECTION»

The head of department _____
(first name, last name, science degree, rank)
_____ « ____ » _____ 20____y.
(signature)

THE DIPLOMA PROJECT

Topic: Development of an order accounting application for a service center
Specialty: 5B070400 - «Computer hardware and software»
Created by: Karim Iskakov Group: VTk-16-1
Head: D. T. s., professor Galym Kaziev Zukharnaevich

Advisors:

Economic part: c.e.s., docent _____ Gabelashvili K.R.
« ____ » _____ 2020y.

Life safety part: c.b.s., docent _____ Musaeva Zh.K.
« ____ » _____ 2020y.

Using of computer technology: the senior teacher _____ Aitkulov Zh.S.
« ____ » _____ 2020y.

Head of control standards: the senior teacher _____ Absatarova B.R.
« ____ » _____ 2020y.

Reviewer: IITU. PhD, assistant, professor _____ Mukazhanov N.K.
« ____ » _____ 2020y.

Almaty 2020

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REPUBLIC OF KAZAKHSTAN
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«ALMATY UNIVERSITY OF POWER ENGINEERING AND
TELECOMMUNICATIONS NAMED GUMARBEEK DAUKEYEV»
Institute of management systems and information technologies
Specialty: 5B070400 - «Computer hardware and software»
Department of «IT engineering»

For the completion of the diploma project
THE TASK

Student: Karim Iskakov

Topic: Development of an order accounting application for a service center

«__» _____ 20__ y. №__ was approved by the order of the university.

Deadline for completion of completed work: «__» _____ 2020 y.

Source data for the project(characteristics of the required project results and object source data): This diploma project is the development of an application for accounting for service center orders.

List of issues to be developed in the diploma project or summary of the diploma project:

- a) Domain analysis;
- b) Designing a web application;
- c) Creating software;
- d) The economic part;
- e) The life safety part;
- f) Appendix A.The content.

List of drawing (you have to specify the drawing materials that are being produced) materials: 13 charts, 33 pictures were introduced.

The main recommended literature:

1 Абрамов, Г.В. Проектирование информационных систем: учебное пособие / Г.В. Абрамов, И.Е. Медведков, Л.А. Коробова. Воронеж: ФГБОУВПО «ВГУИТ», 2016. 700 с.

2 Андрейчиков, А.В., Андрейчикова О.Н. Интеллектуальные информационные системы: Учебник / Андрейчиков А.В. М.: Финансы и статистика, 2017.

3 Владыкина Л.И., Экономика, организация и стратегическое планирование: учебное пособие / Л.И. Владыкина, М.И. Степанов, Э.С. Яковлев. М.: ПРИОР. 2018. 320с.

4 Гагарина, Л.Г. Разработка и эксплуатация автоматизированных информационных систем: учебное пособие. /Л.Г. Гагарина. М.: ИД ФОРУМ: НИЦ Инфра, 2018. 384с.

Consultants, established in respect of the units under the project

Departments	Consultants	Time	Signature
The economic part	Gabelashvili K.R.	15.04.2020 – 30.04.2020	
The life safety part	Musaeva Zh.K	15.04.2020 – 30.04.2020	
Software developing	Aitkulov Zh.S	13.05.2020 – 18.05.2020	
Normative control	Absatarova B.R	13.05.2020 – 18.05.2020	

Preparation of the diploma project
CHART

№ p/p	Title of the chapter, list of issues being developed	Time	Comment
1	Theoretical part	14.02.2020 - 18.03.2020	
2	Designing a software application	18.03.2020 - 02.04.2020	
3	Software developing	02.04.2020 - 10.05.2020	

Date the task was issued « ___ » _____ 20 ___ y.

Head of department _____ Doszhanova A. A.

Reviewer: _____ Kaziev G.Z.

Task in progress
accepted student _____ Iskakov K.A

ANNOTATION

Topic: «Development of an order accounting application for a service center»

The diploma project has 75 pages which includes 33 pictures and 13 charts. During the writing of the diploma project 20 sources were used.

The object of research in preparation of the work is a service center for digital devices service.

The main subject of the diploma is studying the activity of the service center to service digital devices.

The diploma project includes an introduction, an analytical part, a design part, an experimental part, a technical and economic part, a life safety chapter, a conclusion to each chapter, and a conclusion to the entire work.

The introduction describes the relevance of the diploma project in this direction, clarifies the purpose and objectives of the work, defines the object and subject of the diploma project, sets the purpose and objectives, and specifies the methodological basis of the project, its theoretical and practical significance.

The analytical part specifies the direction of development and automation, analyzes the subject area, and selects tools for program development.

The conclusion summarizes the results of the analytical analysis.

The project part describes the development of the software package. The system of business processes of the enterprise is described, flowcharts of processes are constructed, a database is developed, and the process of developing a software package is described.

The output for it describes the development result.

The experimental part describes test runs, errors and their solutions, user instructions, and suggestions for further improvement of the system.

The conclusion on it shows the results of the chapter.

The technical and economic part provides the economic justification of the project.

The output of the part contains its summary information.

The chapter of life safety contains information about threats that occur when working with the system.

The conclusion is devoted to the main conclusions and results of the diploma project.

АННОТАЦИЯ

Тема: «Создание автоматизированного рабочего места сотрудника сервисного центра»

Дипломная работа состоит из 75 страниц, которые включают в себя 33 рисунка и 13 таблицы. При написании дипломной работы применялись 20 источников.

Объектом исследования при подготовке работы является сервисный центра по обслуживанию цифровых устройств.

Предметом исследования диплома деятельность сервисного центра по обслуживанию цифровых устройств.

В дипломная работа включает в себя введение, аналитическую часть, проектную часть, экспериментальную часть, технико-экономическую часть, главу безопасности жизнедеятельности, вывод к каждой главе, заключение по всей работе.

Во введении описывается актуальность дипломной работы по указанному направлению, уточняются цель и задачи работы, определяются объект, предмет дипломной работы, ставятся цель и задачи, указывается методологическая база работы, его теоретическая, практическая значимость.

В аналитической части указано направление разработки и автоматизации, проведен анализ предметной области, выбраны средства для разработки программы.

В выводе по ней подводятся итоги по аналитическому анализу.

В проектной части описана разработка программного комплекса. Описана система бизнес процессов предприятия, построены блок схемы процессов, разработана база данных, описан процесс разработки программного комплекса.

В выводе по ней описывается результат разработки.

В экспериментальной части описаны тестовые запуски, ошибки и их решения, инструкция пользователя, а также предложения по дальнейшему улучшению системы.

В выводе по ней приведены итоги главы.

В технико-экономической части приведено экономическое обоснование проекта.

В выводе по части содержится ее обобщенная информация.

В главе безопасность жизнедеятельности содержится информация об угрозах, возникающих при работе с системой.

Заключение посвящено основным выводам и результатам выполнения дипломного проекта.

АННОТАЦИЯ

Тақырыбы: «Қызмет көрсету орталығына тапсырыстарды есепке алу қосымшасын әзірлеу»

Дипломдық жұмыс 75 беттен тұрады, олар 33 сурет пен 13 кестені қамтиды. Дипломдық жұмысты жазу кезінде 20 дереккөз қолданылды.

Жұмысты дайындау кезінде қызмет көрсету орталығына тапсырыстарды есепке алу қосымшасы құрылды.

Дипломның зерттеу пәні цифрлық құрылғыларға қызмет көрсету бойынша сервистік орталықтың қызметі.

Дипломдық жұмыста кіріспе, аналитикалық бөлім, жобалық бөлім, тәжірибелік бөлім, техникалық-экономикалық бөлім, тіршілік қауіпсіздігі тарауы, әрбір тарауға қорытынды, барлық жұмыс бойынша қорытынды кіреді.

Кіріспеде көрсетілген бағыт бойынша дипломдық жұмыстың өзектілігі сипатталады, жұмыстың мақсаты мен міндеттері нақтыланады, дипломдық жұмыстың объектісі, пәні анықталады, мақсаты мен міндеттері қойылады, Жұмыстың әдіснамалық базасы, оның теориялық, практикалық маңыздылығы көрсетіледі.

Талдау бөлімінде өңдеу және автоматтандыру бағыты көрсетілген, пән саласына талдау жүргізілді, бағдарламаны әзірлеу үшін құралдар таңдалған.

Қорытындыда ол бойынша аналитикалық талдау бойынша қорытындылар шығарылады.

Жобалау бөлімінде бағдарламалық кешенді әзірлеу сипатталған. Кәсіпорынның бизнес үдерістерінің жүйесі сипатталған, үдерістер схемасының блогы құрастырылды, деректер базасы әзірленді, бағдарламалық кешенді әзірлеу процесі сипатталған.

Қорытындыда ол бойынша әзірлеу нәтижесі сипатталады.

Эксперименталды бөлімде тесттік ұшулар, қателер және олардың шешімдері, пайдаланушының нұсқаулығы, сондай-ақ жүйені одан әрі жақсарту бойынша ұсыныстар сипатталған.

Ол бойынша қорытындыда тараудың қорытындылары келтірілген.

Техникалық-экономикалық бөлімде жобаның экономикалық негіздемесі келтірілген.

Қорытындыда бөлім бойынша оның жалпыланған ақпараты бар.

Өміртіршілік қауіпсіздігі тарауында жүйемен жұмыс істеу кезінде туындайтын қауіптер туралы ақпарат бар.

Қорытынды дипломдық жобаны орындаудың негізгі қорытындылары мен нәтижелеріне арналған.

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Explanatory note

One of the main factors in maintaining the company's competitive position in the market is the speed and accuracy of information processing. In this regard, more and more aspects of the work of various companies are being transferred to electronic format. This allows you to significantly speed up the processing of information, and improve its accuracy by reducing the influence of the human factor.

All companies have a huge daily turnover of different information. Accordingly, the informatization of activities is necessary in the first place. Many different software tools allow you to automate the company's activities, but most of them are focused on specific goals or cover issues that are too General and often do not allow you to cover all the areas that are necessary at the moment. There are also General-purpose software products (for example, 1C accounting) that help different companies, but in one area. Accordingly, it is more convenient for most companies to order the development of software designed specifically for the needs of this company.

Digital technology includes devices that operate based on discrete signals. These include computers, smartphones, and similar equipment.

In the sphere of companies engaged in servicing, repairing, selling, and configuring digital equipment, there are often a lot of different processes that are better automated to simplify data storage, as well as reduce the likelihood of errors. The main processes of such information systems include: selling products, accepting orders, issuing orders, distributing work among employees, and so on. Usually, the flow of information in these processes is quite large, which is why they often have overlaps and errors. For this reason, the main module being developed is the automated information system of the service center for automating the work of sellers and reporting masters, as well as for monitoring the activities of the administration.

In this final qualification work, a prototype of an information system for a service center for digital equipment maintenance was developed. During the implementation, a full-fledged automated information system was created, consisting of four automated jobs: the administrator's place; the storekeeper's place; the master's place; the Manager's place. This information system covers all the main activities of the service center.

Modern programming languages and software development technologies were studied during the development of the information system. The service center information system was designed in C++ in the Embarcadero XE8 programming environment using the Fast Report library. The SQL query language was also used to work with the database.

A relational database was created with functions for storing, deleting, editing and adding the necessary information. The created program also protects incorrect information input.

The software package has passed all tests and is ready for implementation. The developed information system successfully solves all the tasks. The productivity of employees and the quality of processed information has increased many times.

Based on the above, we can conclude that the created information system of the service center for the maintenance of digital equipment significantly increases the company's profit, is not only self-sustaining but also fully profitable. Also, it is worth noting that this system is very popular not only among service centers for servicing digital equipment but, with a small change, in other service centers. In the future, it is planned to implement the product introduction to other companies in this industry.

In this final qualification work, a prototype of an information system for a service center for digital equipment maintenance was developed. During the implementation, a full-fledged automated information system was created, consisting of four automated jobs: the administrator's place; the storekeeper's place; the master's place; the Manager's place. This information system covers all the main activities of the service center.

Introduction

The relevance of this work is that the volume of information processed by the service center is growing every year and it is necessary to improve the quality and speed of working with data. It is planned to improve quality by implementing an information system. If the company does not have such an electronic system, there is a risk that the company will not be able to correctly process the growing volumes of information, as well as correctly perform all calculations, and may close down, unable to withstand the growing competition.

One of the main factors in maintaining the company's competitive position in the market is the speed and accuracy of information processing. In this regard, more and more aspects of the work of various companies are being transferred to electronic format. This allows you to significantly speed up the processing of information and improve its accuracy by reducing the influence of the human factor.

All companies have a huge daily turnover of different information. Accordingly, the informatization of activities is necessary in the first place. Many different software tools allow you to automate the company's activities, but most of them are focused on specific goals or cover issues that are too General and often do not allow you to cover all the areas that are necessary at the moment. There are also General-purpose software products (for example, 1C accounting) that help different companies, but in one area. Accordingly, it is more convenient for most companies to order the development of software designed specifically for the needs of this company.

The object of research is a service center for digital equipment maintenance.

Digital technology includes devices that operate based on discrete signals. These include computers, smartphones, and similar equipment.

In the sphere of companies engaged in servicing, repairing, selling, and configuring digital equipment, there are often a lot of different processes that are better automated to simplify data storage, as well as reduce the likelihood of errors. The main processes of such information systems include: selling products, accepting orders, issuing orders, distributing work among employees, and so on. Usually, the flow of information in these processes is quite large, which is why they often have overlaps and errors. For this reason, the main module being developed is the automated information system of the service center for automating the work of sellers and reporting masters, as well as for monitoring the activities of the administration. The subject of the research is the activity of a service center for servicing digital equipment.

The purpose of the final qualification work is to develop an automated information system for a service center for digital equipment maintenance.

When developing an automated information system it is necessary to solve the following tasks:

- study and analyze the company's activities;
- review and select technologies for the development of an information system;

- create a database by the data structure of the service center;
- develop a user-friendly DBMS for working with the database;
- create three modules: an information system for service center salesmen, a system for reporting masters, and a monitoring system for service center administration [5, p. 102];
- configure mutual integration and interaction of modules;
- restructure the service center's business processes;
- write user instructions for working with the program;
- form a proposal for system modernization;
- calculate the economic efficiency of using the information system.

The final qualification work consists of an introduction, three sections, a conclusion, and a list of sources used.

The first section contains a general description of the service center's activities. The existing programs for enterprise automation are analyzed. Software tools for information system development were also selected.

In the second section, models of business processes of a service center for digital equipment maintenance are developed. The database structure is developed and the database schema is presented. Algorithms and models of the information system are developed, as well as the user interface is implemented.

The third section presents possible ways to modernize the information system and user-oriented instructions for working with the program. An analysis of the economic efficiency of the software product was also made.

1 The analytical part

1.1 Analysis of the subject area

Digital technologies are technologies in which data is transmitted using discrete signals in bands of analog levels, most often such signals have 3 values: 0, 1, NULL. Digital devices include:

- cell phones;
- digital camera;
- digital video camera;
- computers;
- game console.

Maintenance of digital devices means:

- repair and maintenance of equipment parts;
- Maintenance and configuration of hardware-software.

Repair and maintenance of equipment parts can be both simple and complex. Simple maintenance includes such types as installing protective glass, cleaning from dust and replacing the thermal paste, minor button repairs, repairs after water ingress, and so on. Complex repairs include those cases where direct repairs with the replacement of parts are necessary. For example, replacing the screen, replacing burned-out capacitors, fixing problems in the electrical circuit, and so on.

Software maintenance and configuration are divided into complex and simple types. Simple means installing common simple programs, clearing cache and clogged memory, and fixing minor system failures. Complex tasks include reinstalling the operating system, installing rare exclusive SOFTWARE, updating the software, fixing the registry, and restoring data from the storage media. It is also worth noting that the service center complies with license rights, and therefore does not work with hacked software.

Information systems are used in an increasing part of companies' activities [4, p. 230]. It often happens that a company wants to fully automate its activities, but it is too difficult to develop, then implement and administer such a product. In this case, you should split the information system into separate interacting modules. A modular information system design system is a division of a large program into some modules by function or object principle [3, p. 24].

An automated information system is usually understood as an automated multi-user software that allows you to informative work with various documentation, both working and managerial, used in the company, as well as automate many workflows. Such a system usually includes several automated workstations [1, p. 143].

With the help of implemented technologies, key employees of the enterprise will be able to process much more and faster information that comes to them during their work. The employee no longer has to focus on additional tasks that will be automated, since the automated workplace allows faster processing and structuring

of information, and then sending all the data to a remote server that hosts a shared database of various data types [27, p. 98].

Advantages of using automated control systems in the enterprise

The use of workplace automation provides many advantages in the direction of saving time and money. Using the APM allows you to:

1) Reduce the number of staff to perform the same business processes. This reduces the cost of staff salaries.

2) Increasing the speed of processing information flows by one person

3) Increasing the speed of one person up to two times, due to the lack of information delays, as well as the lack of additional links in the chain of information transmission [20, p. 46].

4) APM allows you to keep statistics on the work of personnel, which is an inherent advantage for the controlling personnel.

5) when using APM, most of the information flows are digitized, which is currently vital (for the enterprise) need, for more convenient further data processing. We should also mention getting rid of the use of paper.

All these points also have a positive impact on the satisfaction of the company's customer service. This increases the likelihood of subsequent requests for the same services in the future, as well as advertising and compliance of the company with high standards of customer service quality [19, p. 87].

1.2 Market research for the creation of APM systems

To create an automated workplace, you can use the capacity and full-time employees. Since there are solutions on the market that allow you to create complex solutions without in-depth knowledge of programming. But the price for such solutions is very high, and often leads to errors and failures in the work, since the staff does not have a deeper knowledge of creating complex solutions. For this reason, most businesses turn to specialists for help. Specifically, third-party companies that specialize in this area. There are many highly specialized solutions from third-party companies on the market [33, p. 106]. But often companies offer products together with their specialists, who will adopt the proposed solution to individual orders.

The downside is that the product implementation services offered by such companies are very expensive, and due to the use of specific technologies, and often even the use of the developed language itself, which most specialists refuse to work with, who could provide these services for much less cost. The disadvantages can also be attributed to the fact that third-party companies may require huge amounts of money to support and update their software product.

For this reason, we will review several existing solutions on the market that are offered for automated systems.

Solutions must be analyzed to identify the main disadvantages.

MasterData

The company offers to “Become a part of the new digital economy” on its main website and offers its services for business process automation. The company offers assistance in data migration, deployment of various types of standard solutions, as well as the development of individual solutions, which is a necessity for the problem area under consideration [20, p 34].

The company offers development of data migration scenarios. The integration and cleaning of data from various sources.

But the price for providing these services is huge.

1C Modules.

Many companies on the market develop individual modules for the 1C software package. The problem is that specialists who are engaged in the development and support of such modules require a high cost for the implementation of an individual module, a specific enterprise. At the same time, this specialist will most likely remain to administer the module in the future, since the module was developed individually, there are not so many specialists who will take on someone else's module. Which carries a huge financial burden [23, p. 166].

Textsoft.

This company offers services for creating CRM systems. Which is primarily intended for automating customer relations.

The list of features describes performance, integration(chats, Internet telephony, warehouses, or payment systems)and data control, as well as data security.

Conclusion.

There are a large number of companies on the market that are ready to help automate business processes. But the problem is that for highly specialized areas, prices for such services are suitable only for large enterprises.

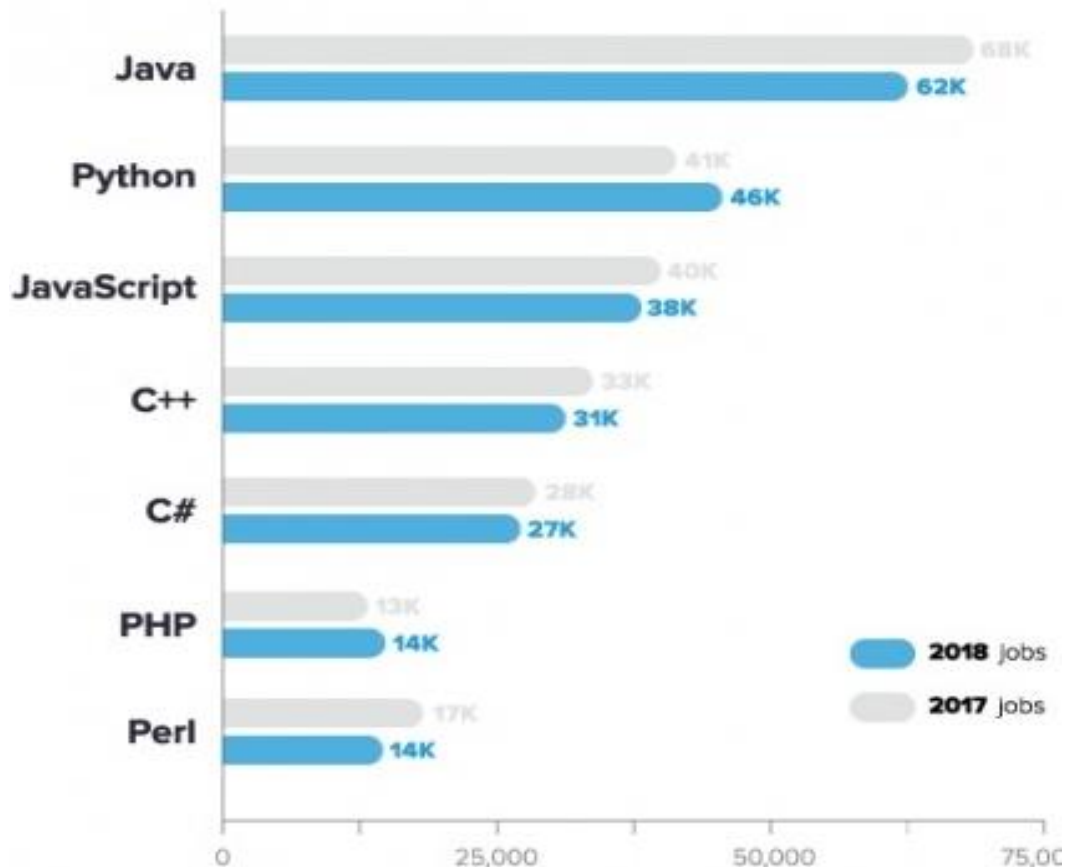
1.3 Justification for choosing the programming language and development environment for the AIS service center

Today, information science has developed very much. There are many different programming languages, both universal and aimed at solving certain tasks. In this paper, we will consider the choice of three popular programming languages based on the author's knowledge of the work and compliance with the requirements for developing an information system [12, p.230]. Below is a graph of the demand for programming languages in the field of document management and information systems.

PHP is a high-level general-purpose scripting language. It is mainly used for developing web applications. It is used as the language of the server part of most sites [11, c. 221]. The main advantages of this language include:

- flexibility – this programming language can be very easily linked to systems written in other programming languages. Also, PHP can run on most server shells and is essentially a platform-independent language;

- security – PHP has a wide range of flexible and effective security features. It includes some reliable data encryption mechanisms, as well as a set of tools for effectively ensuring a system of an administrator – user access levels;
- free distribution-the PHP language is completely based on the Open Source and free source distribution policy.



Picture 1 - Graph of demand for programming languages

Simplicity-the PHP language does not require loading any libraries or special compilation settings. The code can consist of either 10,000 lines or just 1 line. Provided that the correct syntax was followed, the code will perform exactly what the programmer wanted [15, p. 321].

The disadvantages of PHP include:

- inconsistent function syntax-PHP has a large number of functions developed by different groups of programmers. As a result, it often happens that the functions of a single block, such as working with strings, can differ dramatically in writing[29, p. 245]. As a result, programmers get confused and have to constantly check the instructions;
- lack of multithreading support-PHP cannot implement multithreading support for data processing with standard functions. Therefore, this language is not suitable for applications that require synchronous data processing and access to resources;

- Java is an object-oriented programming language. It is famous for its multiplatform nature. It became especially popular thanks to the Android phone operating system.

Advantages of the Java language:

- object-oriented. in this language, everything is an object[13, p. 210]. It can be easily extended because it is based on the object model;

- platform-independent. unlike many programming languages, java is not compiled for a specific machine; it is created in bytecode. This bytecode is interpreted in the jvm that the application is currently running on;

- simple. easy enough to learn. On the internet there is a large amount of material for learning this language;

- safe. there are simple encryption methods for protecting public key data [17, p. 219];

- multithreaded. The multithreading function is to perform multiple tasks at once;

- interpreted. The bytecode is immediately translated into machine instructions and is not stored anywhere [16, p.260]. This makes the process fast and economical;

- disadvantages of the java language:

- speed. due to a large amount of calculated information, it has increased requirements for the amount of ram;

- third-party libraries. There are a large number of third-party libraries that make learning this language more difficult;

- updates. The language is constantly updated and new tools are created [18, p. 110]. This is why the code is getting old and needs to be constantly updated.

The C++programming language. C++ is a statically typed General-purpose programming language. This language supports object-oriented programming, procedural programming, and generic programming. The language has a large standard library that supports multithreading, I / o algorithms, and many other features, as well as many third-party libraries from professional developers. This language combines the properties of high-level and low-level programming languages.

Advantages of C++:

- computational performance. The language gives the developer full control over the entire structure and execution of the program. C++ provides the ability to work with memory at a low level;

- reliable memory management thanks to the automatic calling of object destructors;

- availability. There is a very large amount of educational literature on C++. There are also many development environments for C++ that allows you to choose the one that is more suitable for the developer;

- operator overloading allows you to write expressions over user-defined types shortly and succinctly in a natural algebraic form.

- Disadvantages of C++:

- the presence of multiple languages to perform the same work, which complicates the programming language and makes it suboptimal and insecure;
- C++ can be difficult to learn due to its complex syntax and extensive specification;
- the presence of direct memory management can lead to errors that cause the program to crash due to stack destruction or when accessing incorrectly allocated memory.

Let's look at the comparison of programming languages in the tables. The table below shows a comparison of the considered programming languages by the used paradigms. Programming paradigms are groups of ideas and concepts that help to understand the style of information systems development, roughly speaking, the approach to the development of a given programming language [19, p. 50].

Chart 1 - Paradigms in OOP languages

Opportunity	Programming languages				
	C++	C#	Java	PHP	Delphi
Imperative	+	+	+	+	+
Object-oriented	+	+	+	+	+
Functional	-/+	+/-	-/+	+/-	-/+
Reflexive	-/+	-/+	-/+	+	-/+
Generalized programming	-/+	+	+	+	+
Logical	-	-	-	-	-
Declarative	-	-/+	-	+	-
Distributed	+/-	-/+	+	-	-

An important moment when choosing a programming language for developing an information system is the ability of this language to process data and work with memory. Let's look at a comparison of programming languages based on how they work with memory.

Chart 2 - Data processing in OOP languages

Opportunity	Languages				
	C++	C#	Java	PHP	Delphi
Creating objects on the stack	+	+	-	-	-/+
Unmanaged pointer	+	+	-	-	+
Manual memory management	+	+	-	-	+
Data utilization	-/+	+	+	+	-

Case tools are software that is used to improve and speed up the process of developing an information system. In particular, case tools help you work with the company's business processes, analyze them, and determine the relationship of process elements [20, p.49].

Developing a business process model is necessary to find solutions to optimize the company's activities, which will help you see how the company operates. In the final qualification work, the development of a business model is necessary to identify solutions for optimizing the company's performance.

Currently, many different methods are used to model business processes. These methods operate with different types of models and allow you to focus on different points. They include not only text but also graphical tools that allow you to fully show the main parts of the process and characterize the exact definitions of parameters and relationships of elements. Next, I will analyze the main modeling methods that are used in the development of information systems.

Data Flow Diagram (flow of data). This diagram is used to show the transfer of data from one operation to another. DFD shows the relationship between operations due to information. DFD helps break down a process into logical levels and is therefore the basis for structural analysis of processes. When using this method, each process can be divided into sub-processes, increasing the level of detail. DFD displays how information enters and exits the process, as well as what actions make changes to the information [21, p.130].

IDEF (Integrated Definition for Function Modeling) is a set of methods used to display various details of business processes. These methods work with the help of methodology SADT (Structured Analysis and Design Technique). To create business process models, the IDEF0 and IDEF3 methods are most often used [22, p. 10].

The IDEF0-this method is needed to show the model of process functions. Functions show that should be performed, in the diagram they are shown as blocks, each of which has its number. Arcs are used to link blocks.

BPMN is a business process notation and model that describes business processes in the form of diagrams. BPMN charts are designed for both technical professionals and business users. To do this, the notation uses a standard set of understandable elements that can be used to describe complex constructions. It is also worth noting that the BPMN specification defines how diagrams that display business processes can be converted into executable models. The same process developed in the BPMN specification can also be used in editors from different manufacturers, provided that these editors support BPMN [23, p. 76].

Bizagi Process modeler

Bizagi is a business process management system that allows you to model, execute, automate and analyze business processes. This system includes three modules necessary for fully configuring business processes:

- bizagi process modeler-module for creating business process models in bpmn notation;
- studio-module for developing business processes;

- engine-a process execution module that supports cross-platform functionality using the browser.

The developed business process can be edited, saved, and exported in various formats, such as pdf and html. The BPMN used in Bizagi differs slightly from the classical notation. For example, there is no external entity. However, there are proprietary developments that are not used in other systems, such as the intermediate stage [24, p. 43].

ELMA BPM

The problem with this solution is that some business processes need to be executed using scripts, which negatively affects the use of ELMA BPM, for small businesses where the staff is not properly trained with these solutions.

Also, vendors often consider it necessary to include their languages in the solution, justifying this with the erroneous opinion that this will simplify the work while using more popular languages would simplify learning and the process of using them.

Due to the addition of native languages, it becomes almost impossible to find a specialist who would be engaged in development in this environment. Moreover, there are often situations when specialists may not be on the market at all [12, p.177]. After that, the company that decided to use this product has no choice but to contact the company that developed this solution for help, which of course is a valuable service that monopolizes the market of specialists for this kind of solution.

Bonita Open Solution

This product is also supplied by a French vendor, which is why Bizagi does not have a representative office in the Kazakhstan Republic. Unlike Bizagi, process modeling takes place in a single window, which is very convenient and is a plus over competitors. Serious disadvantages of this solution include frequent shutdowns of the application right during the construction of the scheme, which often leads to the loss of important data[3. c. 9].

Output: After taking into account all the disadvantages, it was decided to use the Bizagi Progress Modeler solution to display the business processes of the enterprise.

After reviewing all the requirements and tasks set by the customer, it was decided to develop modules of the information system in the C++ programming language because user forms are most convenient for the customer, as well as because of the implementation of the ability to automatically create documents in the Microsoft Word environment, and the ability to run the program even on weak devices. In C++, there are basic constructs that allow you to create files immediately in the Microsoft Word extension without using large resources.

The development is planned to conduct in the environment of visual programming Embarcadero Rad Studio and Visual Studio. Visual programming is a method of developing programs by working with graphical objects instead of writing their text. Visual programming is usually referred to as a new level of development of text-based programming languages [25, p.132]. One example of visual programming is Microsoft Visual Studio, where the developer processes

graphical objects and at the same time works with the corresponding program text. These days, visual programming is becoming more popular due to the development of smartphones and tablets. Visual programming is primarily used for developing programs with a graphical user interface for operating systems with a graphical user interface. The visual programming environment helps you develop a Web application for browsers [26, p. 178]. The visual programming environment allows you to create a console application (a program without a graphical interface and without the output of messages to the console) for programming microcontrollers, programmable chips. For this work, Embarcadero Rad Studio was chosen because the company purchased an official license for this SOFTWARE, and also because this Studio has a convenient user-expandable functionality that allows you to solve many tasks.

Conclusions on the section.

In the first section of the final qualification work, the analysis of automated information systems is carried out.

The main requirements for the functionality of the automated workplace of a service center employee were analyzed. The analysis of the subject area of the service center for the maintenance of digital devices was also carried out.

The existing proposals for various automated information systems are considered. Using a comparative analysis of programs, it was concluded that the presented systems do not automate all the necessary functions necessary for the work of the service center's automated control system.

The article analyzes modern CASE-tools that make it possible to systematize and automate the stages of information system development. Bizagi process modeler was selected for process modeling.

Since the information system will consist of several interconnected, but in principle, independent software modules, 3 programming languages, and the SQL language for working with databases are selected for development [27, p. 56]. The C++ language was chosen for development because It is quite flexible, and it is also the most suitable for the task at hand. The visual environment Embarcadero Rad Studio was chosen for C++ design, as this software product is available from the customer. It was decided to use MySQL for database development and storage. The DBMS will interact with the system using the internal tools of Embarcadero Rad Studio, as well as using the SQL structured query language.

2 The design part

2.1 Creating a business process model for a digital device service center using the Bizagi Process Modeler CASE technology

The center's activities include repair of various customer equipment, receiving and issuing equipment, warranty service of equipment, customer service, replacement of components, assistance and advice in handling equipment, sale of components and various products related to the main business, assistance in configuring software and implementing licensed software. The service center works with large devices such as computers and monoblocks, as well as with smaller and more complex electronics such as smartphones and ultrabooks. The service center only works with licensed software and therefore will not undertake the installation of pirated software.

The service center consists of several divisions, and also involved in the activities of specialists involved, which primarily include a narrowly focused master. The service center includes a Department for receiving and issuing orders, a store, and a Department for repairing equipment.

The total number of workers and the responsibilities of staff include:

1) The manager responsible for sales and receiving / issuing orders, as well as for updating the customer database.

2) the Administrator who is engaged in negotiations on large volumes of service work, as well as periodic editing of the database, and correcting data in the presence of defects in the information that may be made by employees of the company in fulfilling their obligations. The duties of the administrator also include the function of the human resources department.

3) a group of masters responsible for working with software and restoring data from storage media.

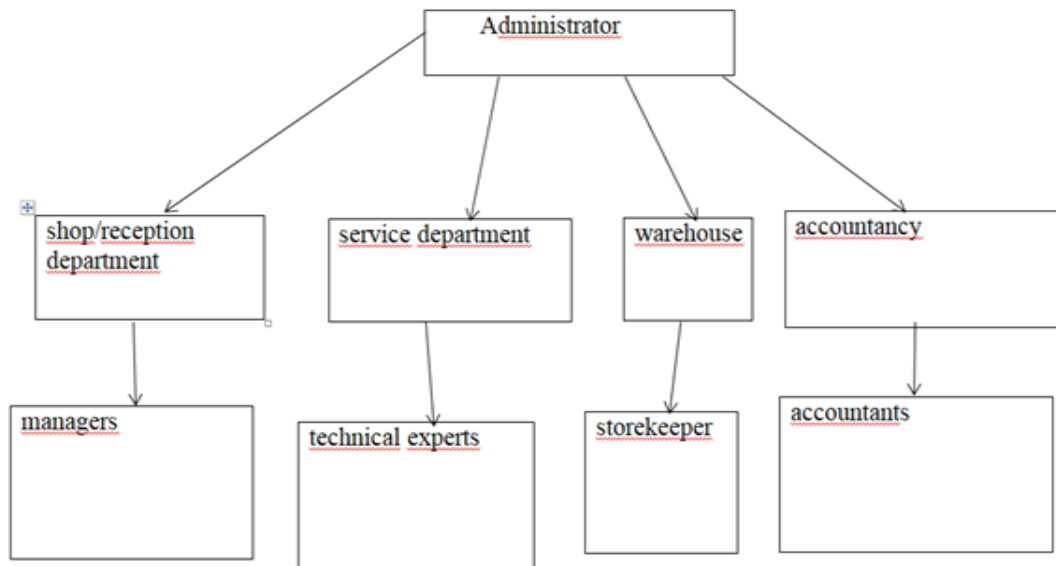
4) a Group of masters responsible for working with equipment.

5) Storekeeper, responsible for entering data about received goods, as well as for preparing for unloading of goods to be sent to the client.

6) Accountant, responsible for summarizing the accounting report and financial statements of the company.

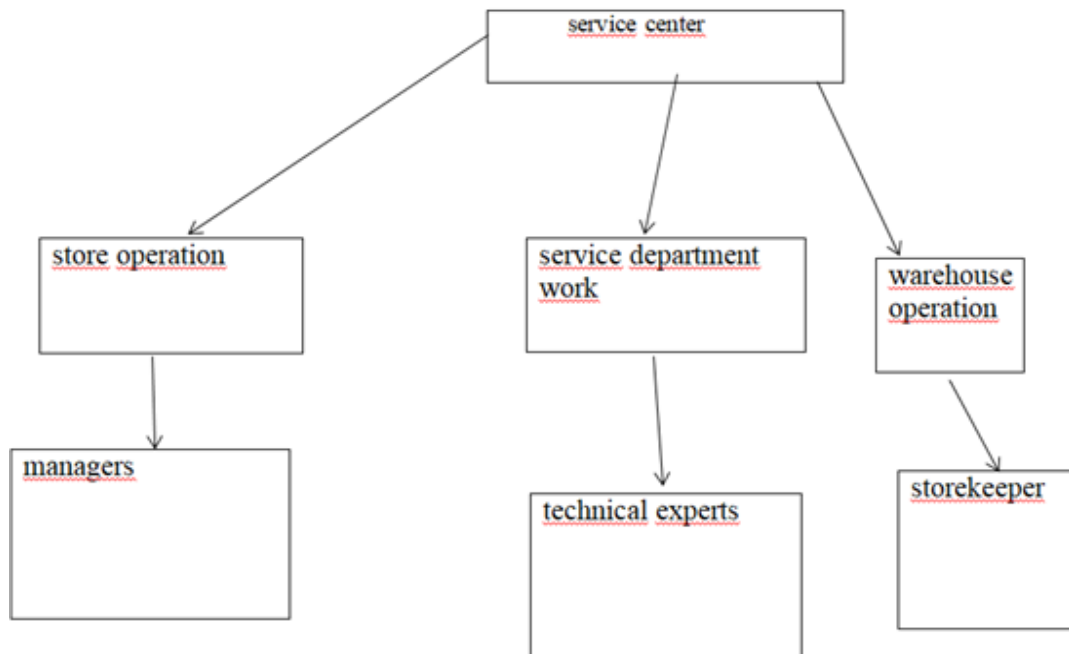
The organizational structure of the service center is shown in the picture.

The service center's activities are divided into several business processes. A business process is a certain sequence of actions that are regularly repeated in the company, and resources from the external environment are used, and at the end of a particular business process, a certain result is provided to the consumer. The main business processes of the service center include servicing customers' equipment and the operation of the store. At the same time, the company has auxiliary business processes that help implement the main process.



Picture 2 - Graph of demand for programming languages

These include: accepting a customer's order, issuing an order, making a list for purchasing, purchasing, and issuing equipment. The General structure of the service center's activities is shown below.

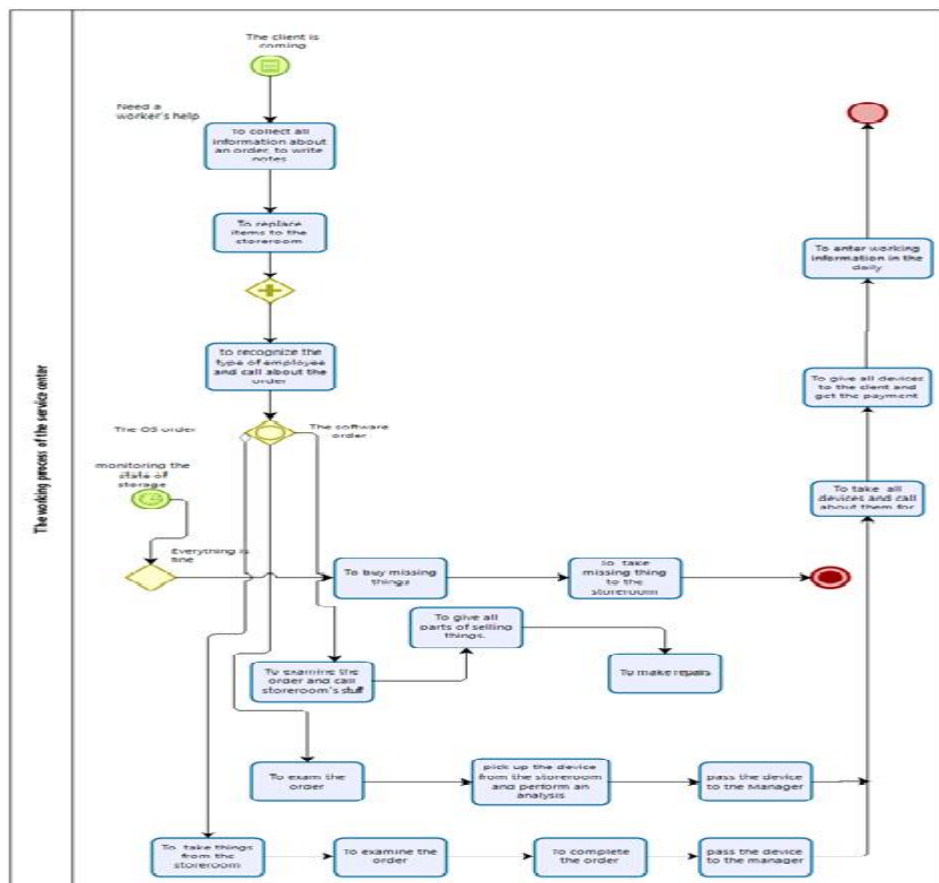


Picture 3 - Structure of the service center's activity

The work of the store/application Department includes sales of the store's products, registration of customers, accepting applications from customers, and issuing ready-made applications to customers. When registering a new request, the Manager also registers a new client in the database. This is necessary first of all in

order to have the customer's contact information, but also for the purpose of implementing a loyalty program. The loyalty program implies that for each call to the service center, the client receives bonus interest. In the case of a subsequent request, the cost of the application will be reduced by these percentages. This move allows you to attract more customers. When making a request, the Manager collects all the necessary information about the device and specifies the type of work. Then the device is transferred to the warehouse.

At the moment, service center employees must constantly contact the warehouse to find out if there are new orders. After the system is implemented, this process is supposed to be automated. All wizards will immediately see the table of pending orders. Accordingly, as soon as the master is released, he can immediately go to choose a new order to work with and start executing it. After completing the work, the master had to take the device to the warehouse, then go to the Manager to inform that the order was ready. This process is also supposed to be automated. Now the wizard just needs to click the "order is ready" button, and the Manager will see it immediately. It is assumed that the Manager should check the table of ready orders 2 times a day, in the morning and an hour before the end of the working day. As soon as they see that another order has been completed, they must notify the customer that they can pick up their device.

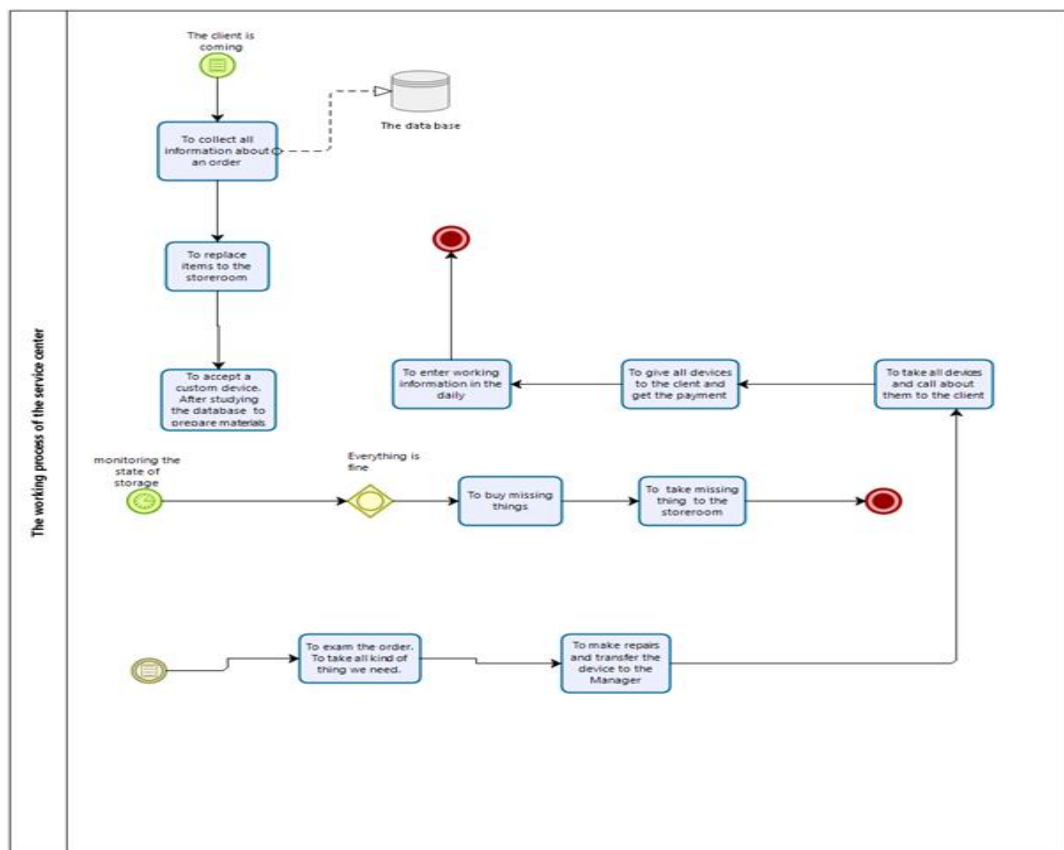


Picture 4 - Diagram of the service center's business processes before restructuring

The storekeeper's job involves monitoring the condition of the warehouse and timely purchasing of missing items. The introduction of information technology will significantly simplify this work and allow you to spend more time searching for profitable suppliers [28, p. 57].

Let's consider the as-is model for the business processes of a digital device service center.

The main business processes of the service center are the operation of the store and servicing customer devices. After the customer makes a request for service, the first available master starts working. Some types of work are done quickly, while others may take several days. The Manager must notify the client about the working hours. Also, the warehouse should always have a stock of the most popular parts so that the repair process does not stall. Masters are divided into those who work directly with the device's iron: this includes cleaning from dust, replacing the thermal paste, repairing or replacing components, and similar work. And those who work with software. Their work includes cleaning the operating system, removing viruses, reinstalling the operating system, debugging programs and the operating system, restoring broken files, and restoring deleted data. There are also exclusive cases, such as correcting errors in the program code or modifying programs. Then the specialists involved are used [14, p. 49]. Below is a diagram of the business process of the service center.



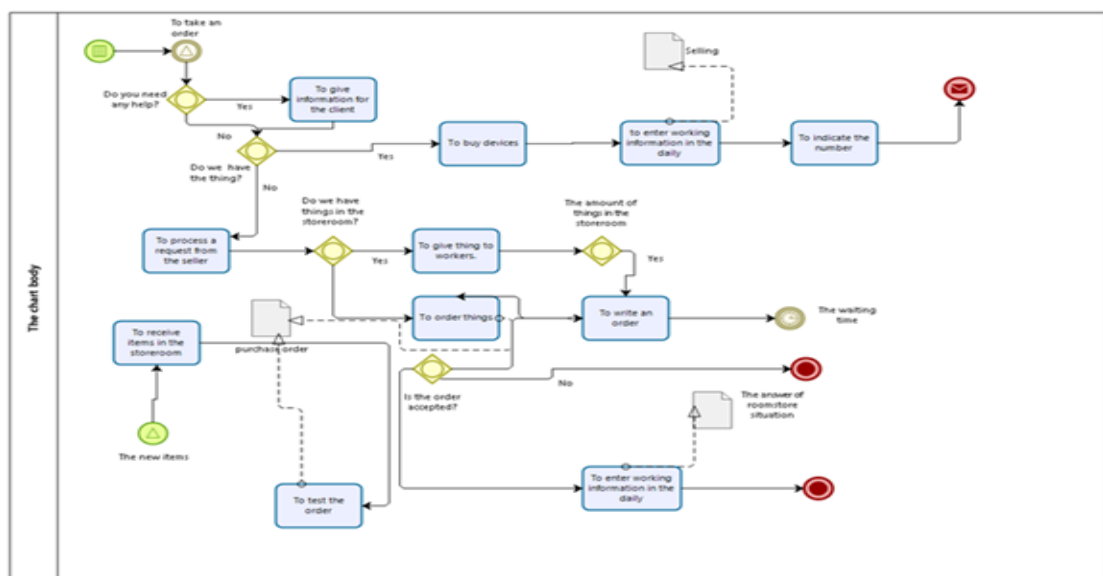
Picture 5 - Diagram of the service center's restructured business processes using IS

After studying the diagram, it becomes clear that the work of the Manager and storekeeper can be significantly simplified by implementing an information system. Working with logs and incoming order information can be easily transferred to the database and automated. At the moment, this procedure takes a very long time.

When building a model, the emphasis should be on full automation of personnel work [29, p. 67]. In fact, after implementing the automated workplace of the Manager, storekeeper and master, you will just need to enter information about the client and order in the database once, after which all participants in the process will get the necessary access to the information. Also, the client is saved in the archive, which allows you not to enter information about this client when you re-apply, and also, it allows you to launch various promotions for regular customers. Below is a diagram of the business process "as it should be".

The second main Department of the service center is the store. The store's business process includes: selling products, consulting clients, making a request for purchasing goods, purchasing and receiving goods to the warehouse. At the beginning of the development of the information system, all the work of the store took place in paper mode. Because of this, the following problems were identified:

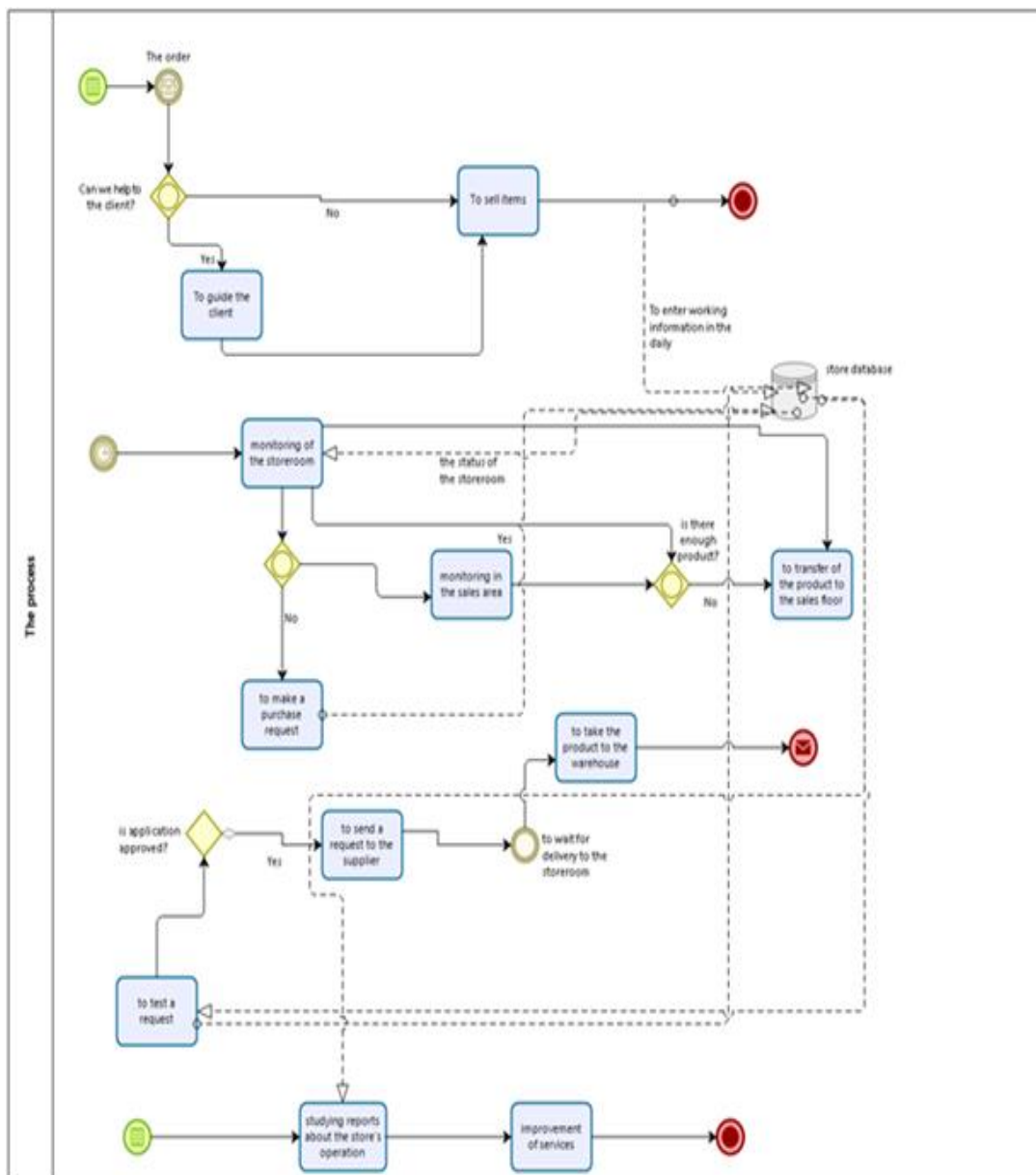
- it was difficult for the Manager to track all the store's processes;
- due to the human factor, mistakes were often made in working with the product. The main ones include-voicing the wrong price; incorrect consultation of the client;
- purchasing goods that are many in stock and Vice versa the product that ran out did not get into the request;
- the product may have been ordered, but not delivered to the warehouse and may have been lost.



Picture 6 - Diagram of the store's business processes before implementing the information system

To solve these problems, increase the level of reports on the store's activities, as well as speed up processing and improve the reliability of information, it was decided to add a store module to the service center module. Below is a diagram of the store's business processes before implementing the information system module, and what the business processes will look like after.

As you can see in this diagram, there is a lot of extra work going on in business processes at the moment. The store's departments do not have operational communication with each other. Documents are generated in paper form and then manually checked. All this takes extra time, and also gives you a chance to lose customers due to staff errors or lack of efficiency. Let's look at the business process diagram after implementing the information system.

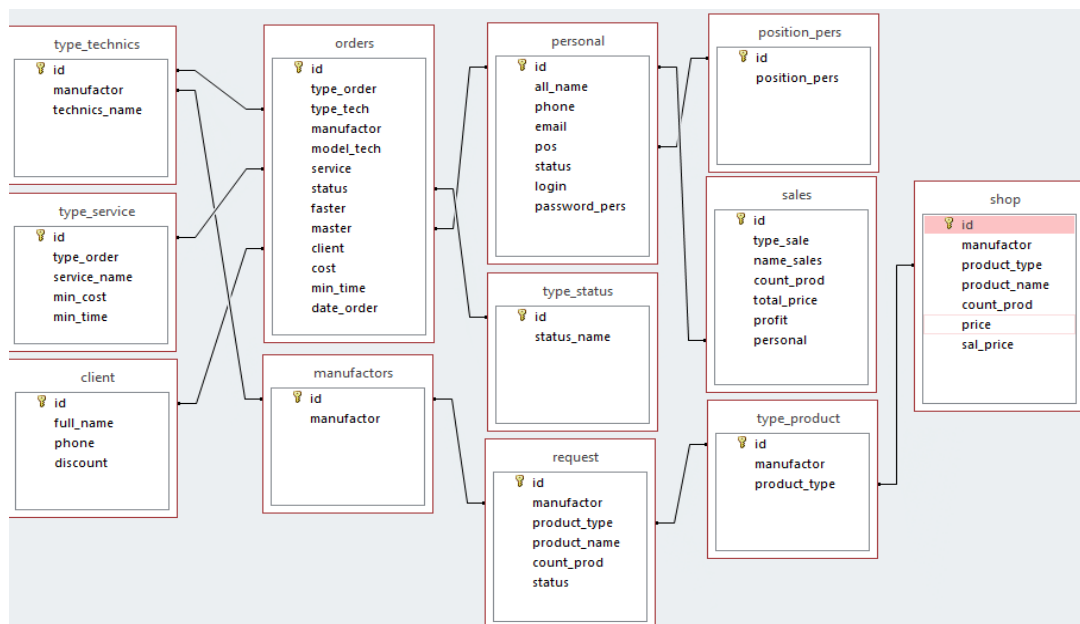


Picture 7 - Diagram of the store's business processes after implementing the IP

As you can see from the business process diagrams, the introduction of the information system module significantly unloads the business process. Such work as editing and generating reports, exchanging information between employees, adding and processing information is completely transferred to the information system, which allows you to buy a lot of time, as well as avoid errors caused by the human factor. At least after the full implementation of the information system and debugging of suppliers, the problem of an important and popular product suddenly not being available is completely solved.

2.2 Implementation of the modular AIS database of a service center for digital device maintenance

When developing the system, a database was designed that contains all the information necessary for the system to work. It was decided to place the database based on Access software for the reason that the customer needed direct access to the database from different devices. The application's work with the database is organized in SQL using the internal tools of the Embarcadero Studio. The database is planned to be hosted on an external server. The database is accessed using SQL language functions and Embarcadero tools. Initially, tables were developed, primary and secondary key columns were defined, and the database schema was created. The database schema describes the structure of tables in the database. It shows tables, fields in tables indicating their names and field types, as well as restrictions in the form of keys (primary, potential, and external). The database schema for the service center is shown in the figure below.



Picture 8 - The structure of the database

When developing the database of the service center's modular information system, 12 tables were created:

Client's Table:

- ID; data type counter;
- full name; data type text;
- phone; numeric data type;
- discount; the data type is numeric.

The client's table contains information about the service center's clients. This information is necessary to contact the customer if necessary and inform them about the results of service, or about an unexpected delay. Also, thanks to this table, a system of discounts is implemented. When registering a new customer, their discount is zero. Then after each service, the customer's discount increases by 1 percent until it reaches 20 percent. It is assumed that such a loyalty system will significantly increase the likelihood of the customer contacting the service center again, as well as recommend this center to their friends.

Table of manufactures:

- ID; data type counter;
- the manufacture; the data type is text;

the manufacturer's table contains information about the manufacturers that the company works with;

the table of orders:

- id; data type counter;
- the order type; the data type is text;
- type of equipment; data type text;
- the manufacture; the data type is text;
- vehicle model; data type text;
- the service type; the data type is text;
- order status; the data type is text;
- the urgency of the order; the data type is text;
- master; data type text.

The table of orders contains information about orders that were placed in the service center. This is the main table with the data that the program works with. This table is used by all employees of the company. The Manager adds new orders to it and uses it to issue finished orders to clients.

The wizard uses this table to accept new orders and specify the order status. The storekeeper can see which orders are currently being processed and prepare everything necessary for repairs in advance.

The order type field can accept 2 types of values, either hardware repair or software configuration. In the type of equipment field, enter information about what type of equipment the order belongs to. Both of these fields are necessary so that the masters who are accepted for the order can immediately filter data by their skill level.

The manufacturer column is mostly used by the storekeeper to select the necessary parts in advance. The order status column contains information about the stage of working with the order.

The urgency field can have 2 values: either urgent or not. If the value is urgent, it means that this work must be done first, and you need to meet the minimum time specified in the corresponding field. The minimum time is specified in hours.

When the wizard starts executing an order, it selects the order it is interested in in the program. After that, its data is entered into the Master field.

Personnel Table:

- ID; data type counter;
- full name; data type text;
- phone number; numeric data type;
- email; the data type is text;
- post; the data type is text;
- status; data type text;
- username; data type text;
- password; the data type is text.

The personnel table contains information about the company's employees. Also, for the convenience of working and filtering, it was decided to place information about employment authorization in this table.

Position Table:

- ID; data type counter;
- job title; data type text.

The positions table contains information about the positions that are used in the company. Depending on the position specified for the employee, after authorization, the corresponding form opens for the employee.

The table of sales:

- ID; data type counter;
- sale type; the data type is text;
- product name; data type text;
- number; data type is numeric;
- total price; data type monetary;
- profit; the money data type;
- the seller; the data type is text.

Table of sales contains information about the products sold. The table contains information about the date of sale, the number of product units, the total amount of this sale, information about the employee who made the sale, and the total revenue from this sale. It is worth noting that this table does not contain data about the entire receipt, but about each product of the same type in the receipt. This is done for the convenience of the customer to simplify the formation of reports. This table also contains information about the profit from completed orders. To separate the store's sales and the service center's revenue, the sales-type field has been added. it can take 2 values: 1st sale, 2nd service.

Store table:

- ID; data type counter;
- the manufacturer; the data type is text;
- product type; the data type is text;
- product name; numeric data type;
- number of products; data type numeric;
- purchase price; data type monetary;
- sale price; data type monetary.

The store table contains information about the product, equipment, and materials in the warehouse and on the sales floor. This table contains data on the number of products, their purchase price, and the sales price. It is worth noting that for convenience and more revenue, it was decided that all the tools used materials for the center's service can also be freely sold in the store itself. For this reason, the same table is used for the service center warehouse and the store warehouse.

Type table of product:

- ID; data type counter;
- manufacturer's name; data type text;
- product type; the data type is text;

The type table of product contains information about all types of products sold in the store or used in the service center.

Type table of service:

- ID; the AutoNumber data type; primary key;
- the order type; the data type is text;
- the name of the service; the data type is text;
- minimum cost;
- minimum time.

The table of service describes all types of services provided by the service center. It is necessary to clarify the difference between the types of orders and types of service. At its core, the service center provides 2 types of services: equipment repair and SOFTWARE configuration. These are the order types. Each of these types is divided into types of services provided, depending on the type of equipment. For example, repairing equipment for a smartphone is divided into replacing the protective glass, replacing the screen, replacing the battery, and so on. Configuring laptop SOFTWARE is divided into reinstalling the operating system, cleaning from viruses, debugging the registry, and so on.

Status type table:

- id; data type counter;
- name status; the data type is text.

The status type table contains information about the values that order processing can accept.

Type table of equipment:

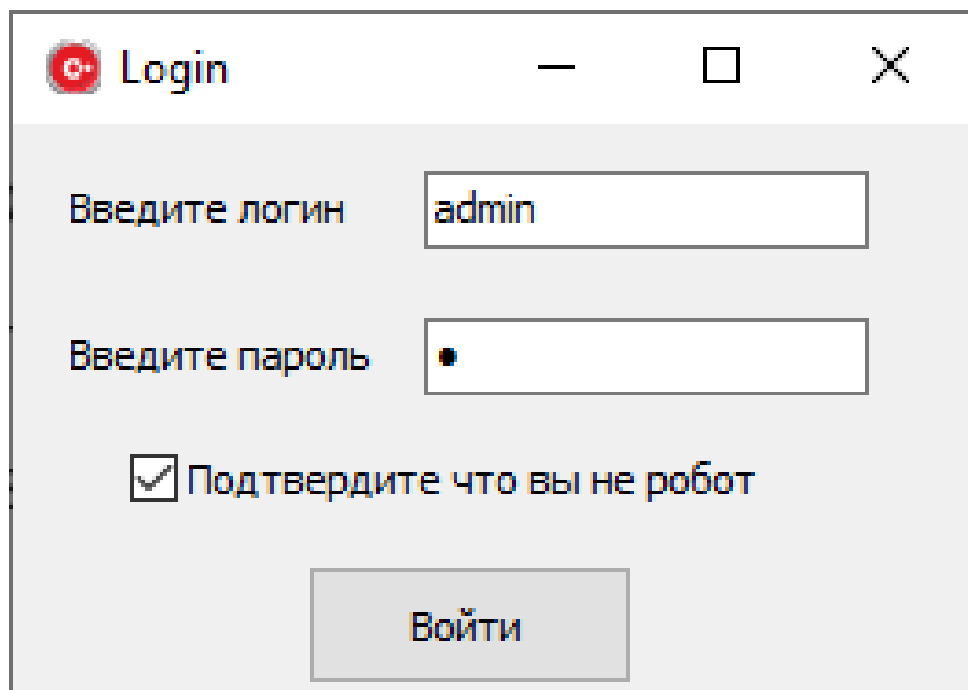
- id; data type counter;
- manufacturer's name; data type text;
- type of equipment; data type text.

The types of equipment table contain information about the types of equipment that are serviced

2.3 Development of custom forms of the information system of the service center for digital equipment maintenance

When developing the information system, the C++ programming language was used, as well as the SQL structured query language. Thus, it was decided to develop the language in the Embarcadero XE8 environment because, firstly, visual objects must meet the requirements of the work, and secondly, Embarcadero supports the use of a very convenient FastReport library that allows you to correctly and fully generate the necessary documents that allow you to fully implement the customer's requirements. Exhibition center module.

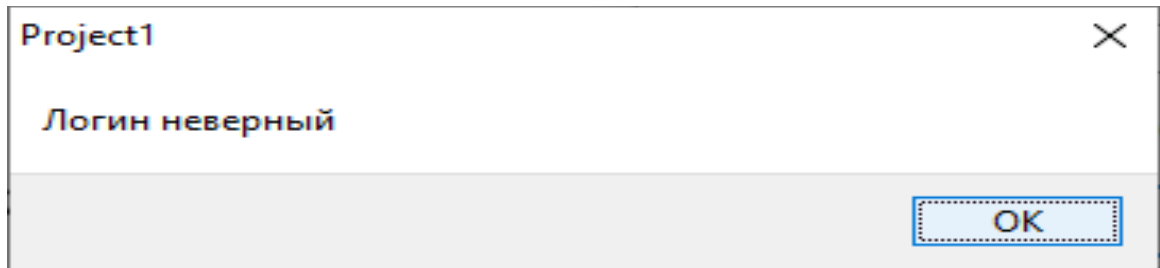
The first form when starting the program is the authorization form. Users can use this form to confirm that they can access the other forms. The form contains Edit objects for entering a username and password, a CheckBox object for protecting against authorization using password matching programs, and a Button object for launching the authorization code. The authorization code is based on queries to a SELECT database, as well as a switch - case container operator.



Picture 9 - Authorization form

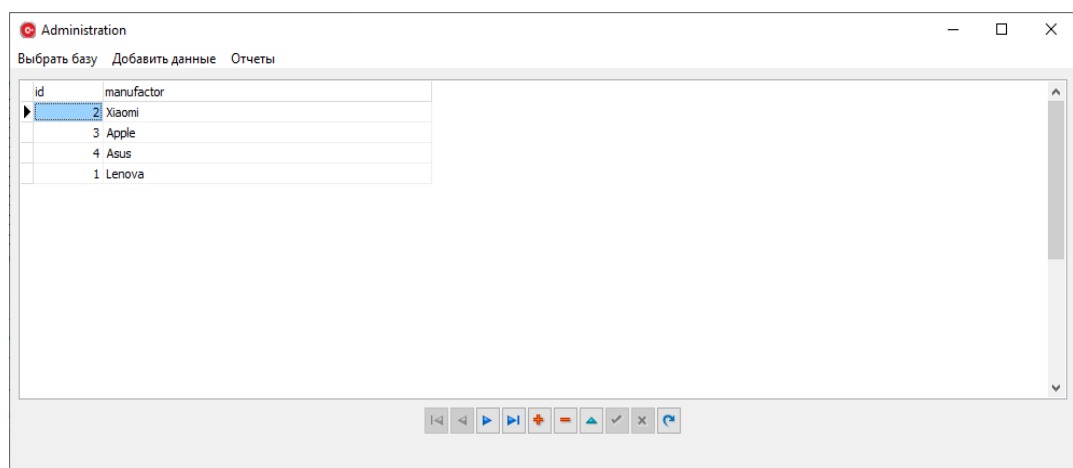
The user must enter the username and password given to him by the administrator after confirming that he is not a robot and click log in. The very first username and password of the base administrator is the standard one and is

immediately entered into the program (login – admin; password – 1) All other users are created using the base account. After the user starts the authorization process, the program compares the entered data with the data stored in the database. First, the program checks whether the entered username is stored in the database. If there is no such login, the program will return an error message and reset the entered data.



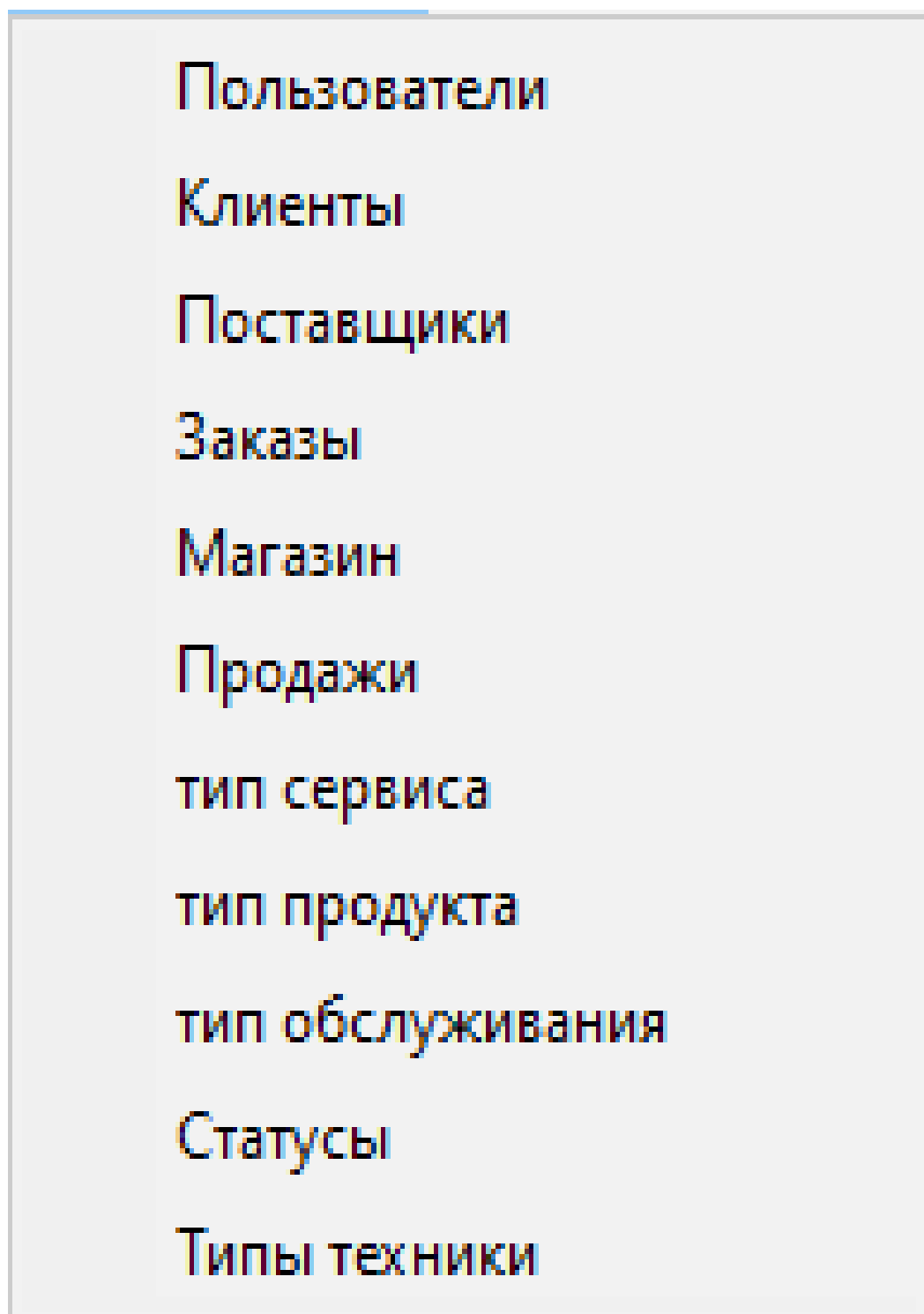
Picture 10 - The message "username is incorrect"

If the entered username was detected in the system, then the program checks whether the entered password matches the password stored in the database. If everything is entered correctly, the program checks whether the robot protection is set. If the data does not match, an error will be returned. If all the data and protection from robots are specified correctly, then the program will check which access level, which depends on the position given to the user, corresponds to this username-password pair. The program administration form opens for the administrator position. For the seller position, the Sales Manager form opens, which allows you to make sales and accept / issue orders. For the master position, a form opens where the masters can start working with the order, view the list of orders, and change the order status. For the position of the storekeeper, a form opens that allows the employee to easily check the condition of the warehouse, and if necessary, make a request for the missing product, or accept the product to the storeroom.



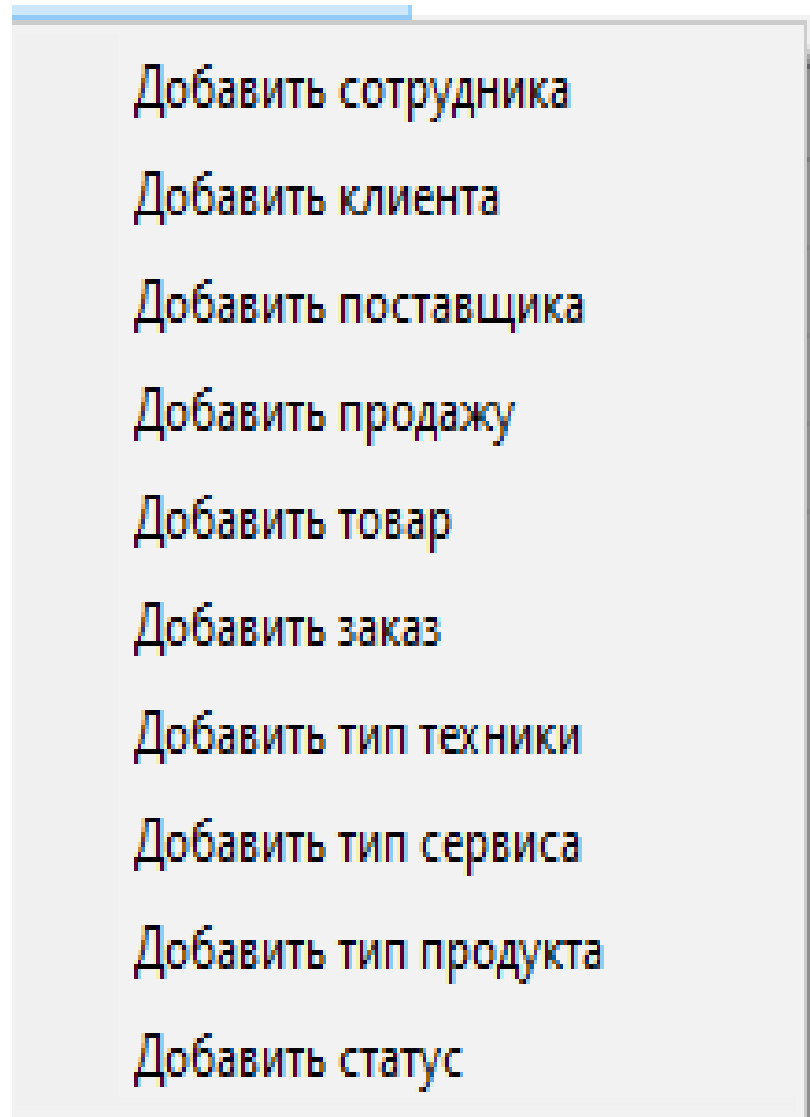
Picture 11–The interface of admin form

This form allows you to view the entire database of the program and, if necessary, enter data or correct / delete information. At the top of the form there is a drop-down menu consisting of two items: selecting a database and adding data. The DB Grid element is located on the form itself, which is responsible for displaying information from the database on the screen. Just below it is the DB Navigation element that allows you to save database adjustments, as well as delete fields.



Picture 12 - Selecting a database on the admin form

Clicking on the select database menu item opens a drop-down list containing a set of buttons, each of which changes the database displayed on the main form.



Picture 13 - The add data menu, the forum administrator

This drop-down menu contains a set of buttons that allow you to enter data correctly into the database. When you click on these buttons, the corresponding form for adding data opens. In addition to this method, data can be added directly to the table using the DB GRID and DB Navigation elements, but this method is not recommended because most tables have fields that can take strictly defined values, and when directly added, a person may make an error in these values. All forms for adding data will be discussed below. Some of them are also used by other users. This decision on the universality of some forms was made to reduce the amount of work and possible errors in the program, as well as duplication of code and functionality.

The image shows a window titled "add_..." with standard Windows window controls (minimize, maximize, close). The form contains the following elements:

- Label: "Введите ФИО сотрудника" (Enter employee's name and surname)
- Text input field: Empty
- Label: "Выберите должность" (Select position)
- Dropdown menu: "Должность" (Position) with a downward arrow
- Label: "Введите телефон сотрудника" (Enter employee's phone)
- Text input field: "Телефон" (Phone)
- Label: "Введите email" (Enter email)
- Text input field: "Email" (Email)
- Label: "Укажите логин сотрудника" (Specify employee's login)
- Text input field: "Логин" (Login)
- Label: "Укажите пароль" (Specify password)
- Text input field: "Пароль" (Password)
- Button: "Добавить" (Add)

Picture 14 - The first look of the admin form

This form allows you to add a new employee to the program. The combo box element contains data from the position table. This element is filled in with data using the SELECT query to the position table when opening this form. It is also worth noting that the phone input field is restricted to Only Numbers so that it is not possible to enter letters and characters. The add button checks the entered data for correctness, checks whether there are no repetitions of the entered username and

logins stored in the database, and then implements the INSERT query to enter data in the database. It is also worth noting that all buttons responsible for opening forms use a non-standard Show () query changed to a more complex query:

```
delete Form2;  
Form2=new TForm2(NULL );  
Form2->Show();
```

Picture 15 - Example of a new code for opening a form

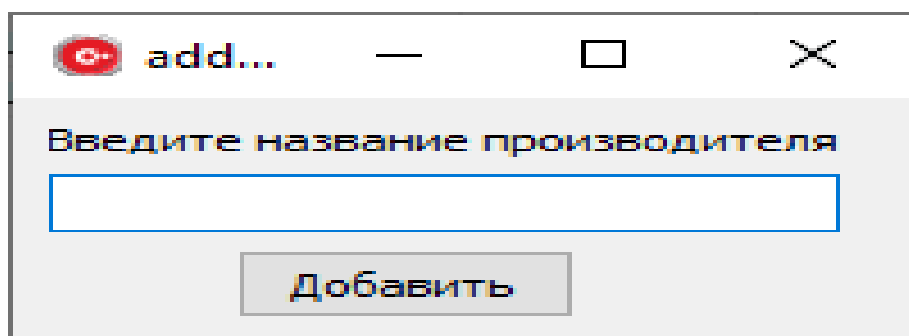
This change to the standard code was decided to do so that there would be no overlaps when closing the form incorrectly, namely, it may happen that the user entered some data, but then decided to cancel the data entry and just closed the form. In this case, the entered data will hang until it is unloaded from the cache, which may lead to errors. There was an option to hang the code responsible for clearing all elements on the OnClose event, but this option is too expensive and less convenient since it would have to weigh different types of code on all forms, and besides, it would load the processor more heavily.

The next button opens the add client form.

Picture 16 - Add client form

This form allows you to add a new client to the database. This form is mainly used by the seller/Manager, but it can also be used by the administrator if necessary.

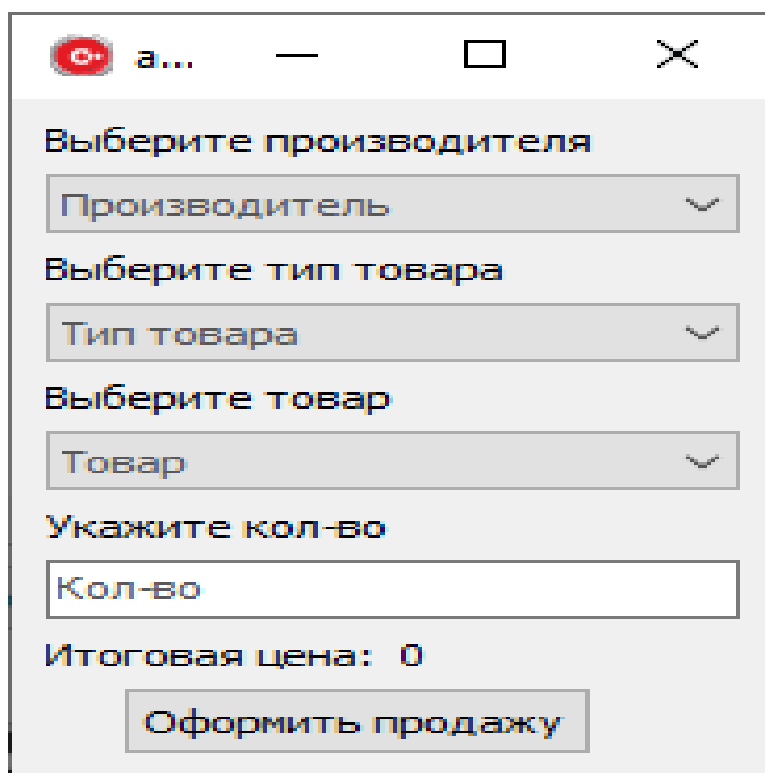
The add manufacturer button opens a form for adding a new manufacturer to the database.

A screenshot of a software window titled "add...". The window has a standard Windows-style title bar with a red icon on the left, a minus sign in the center, a maximize button on the right, and a close button (X) on the far right. The main content area is light gray and contains the text "Введите название производителя" (Enter manufacturer name) in blue. Below this text is a white rectangular text input field with a blue border. At the bottom center of the window is a gray button with the text "Добавить" (Add) in blue.

Picture 17 - Form for adding a manufacture

This form is used exclusively by the administrator. It allows you to add a new equipment manufacturer whose products the service center will work with. The decision to start working with a new manufacturer is made exclusively by the company's management, as this is associated with significant risk and the need to have the necessary parts and components in stock, as well as the necessary qualifications of the staff.

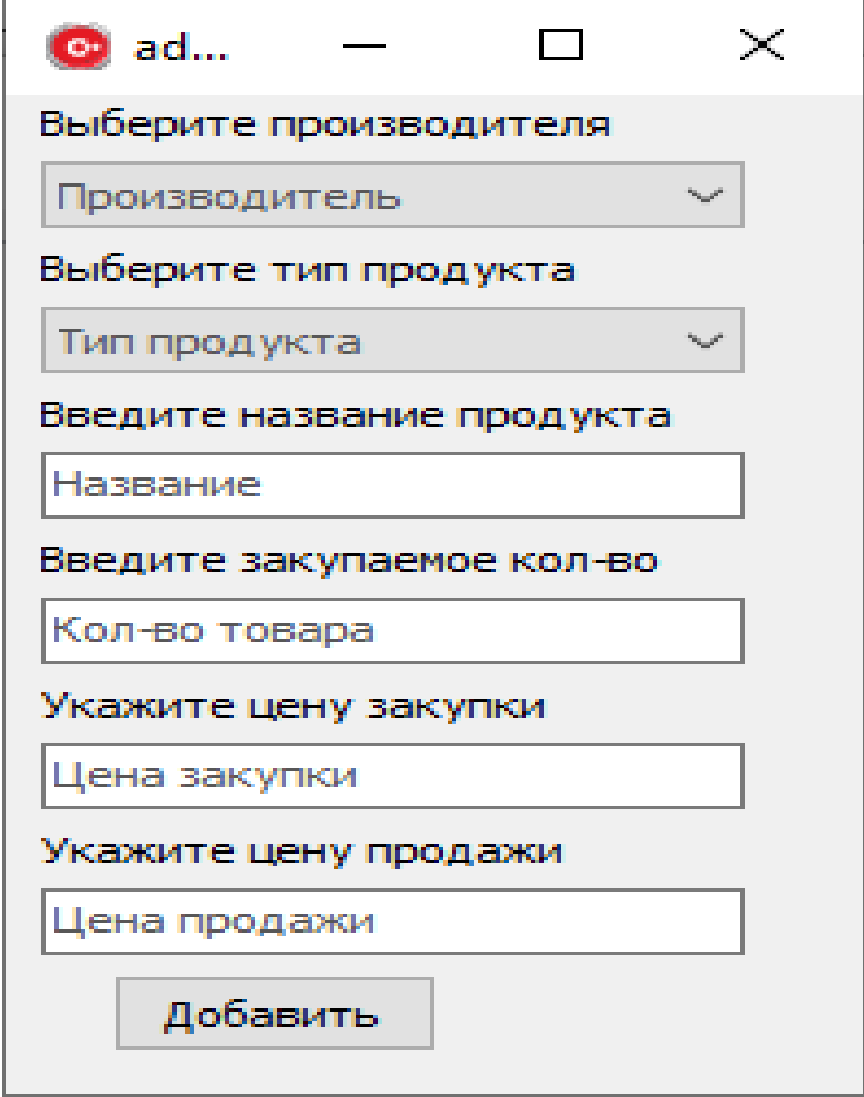
The add sale button opens the registration forms for a new sale.

A screenshot of a software window titled "a...". The window has a standard Windows-style title bar with a red icon on the left, a minus sign in the center, a maximize button on the right, and a close button (X) on the far right. The main content area is light gray and contains several form elements: the text "Выберите производителя" (Select manufacturer) in blue, followed by a dropdown menu with "Производитель" (Manufacturer) and a downward arrow; the text "Выберите тип товара" (Select product type) in blue, followed by a dropdown menu with "Тип товара" (Product type) and a downward arrow; the text "Выберите товар" (Select product) in blue, followed by a dropdown menu with "Товар" (Product) and a downward arrow; the text "Укажите кол-во" (Specify quantity) in blue, followed by a white rectangular text input field with a black border containing "Кол-во" (Quantity); the text "Итоговая цена: 0" (Final price: 0) in blue; and at the bottom center, a gray button with the text "Оформить продажу" (Complete sale) in blue.

Picture 18 - Form of sale

This form is mainly used by the seller of the service center store. But the administrator can also use this form if necessary, for example, if there is no seller and the sale needs to be made urgently. This form allows you to register the sale of an item in the program to get reports and monitor the condition of the warehouse. The first combo box containing information about manufacturers that the service center works with is filled in automatically when creating the form. All subsequent combo boxes are filled in after activating the previous one. This condition is made so that the next combo box is filled with information already filtered by the previously selected item. When you enter all the data, the program itself will calculate how much the specified amount of the selected product will cost. After all the data is entered, and the user clicks the submit sale button, first, the specified quantity of goods will be deducted from the table responsible for the warehouse, then the program will calculate how much profit is made from this sale and enter the data in the sales table. This makes it easy to create reports on profits and sales.

The next button is the Add product button.



The image shows a screenshot of a software application window titled "ad...". The window contains a form for adding a product. The form consists of several sections, each with a label and an input field:

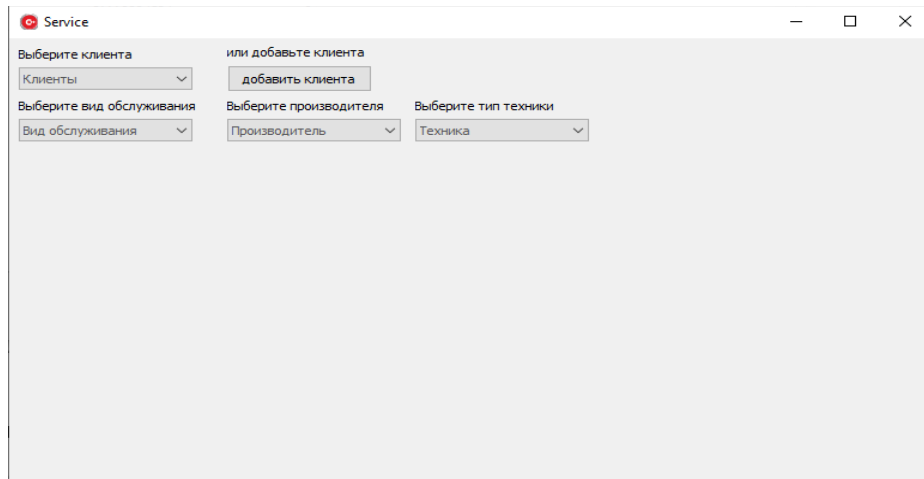
- Выберите производителя**: A dropdown menu with the text "Производитель" and a downward arrow.
- Выберите тип продукта**: A dropdown menu with the text "Тип продукта" and a downward arrow.
- Введите название продукта**: A text input field containing the text "Название".
- Введите закупаемое кол-во**: A text input field containing the text "Кол-во товара".
- Укажите цену закупки**: A text input field containing the text "Цена закупки".
- Укажите цену продажи**: A text input field containing the text "Цена продажи".

At the bottom of the form, there is a button labeled **Добавить**.

Picture 19 - Add product Form

You can use this form to add a new type of product to the warehouse. This form is used only by the administration, as only they have the right to decide about which product can be sold by the service center. After entering all the data and clicking the add button, the new product will be entered into the corresponding table.

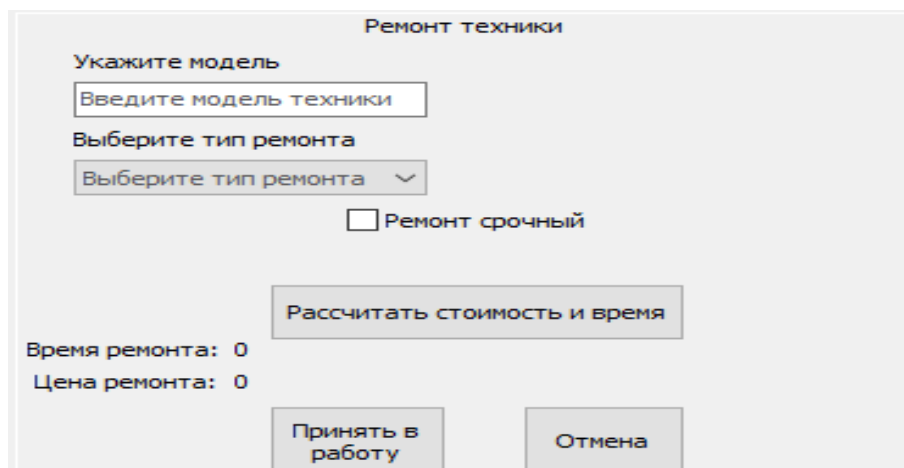
The add order button opens the form for adding an order. When opened at first it looks like this:



The screenshot shows a window titled "Service" with a light gray background. At the top left, there is a red close button and the text "Service". Below the title bar, there are two main sections. The first section is titled "Выберите клиента" (Select client) and contains a dropdown menu with "Клиенты" (Clients) selected. To the right of this section is a button labeled "добавить клиента" (add client) under the heading "или добавьте клиента" (or add client). The second section is titled "Выберите вид обслуживания" (Select service type) and contains a dropdown menu with "Вид обслуживания" (Service type) selected. To the right of this section are two more dropdown menus: "Выберите производителя" (Select manufacturer) with "Производитель" (Manufacturer) selected, and "Выберите тип техники" (Select equipment type) with "Техника" (Equipment) selected.

Picture 20 - Adding form application

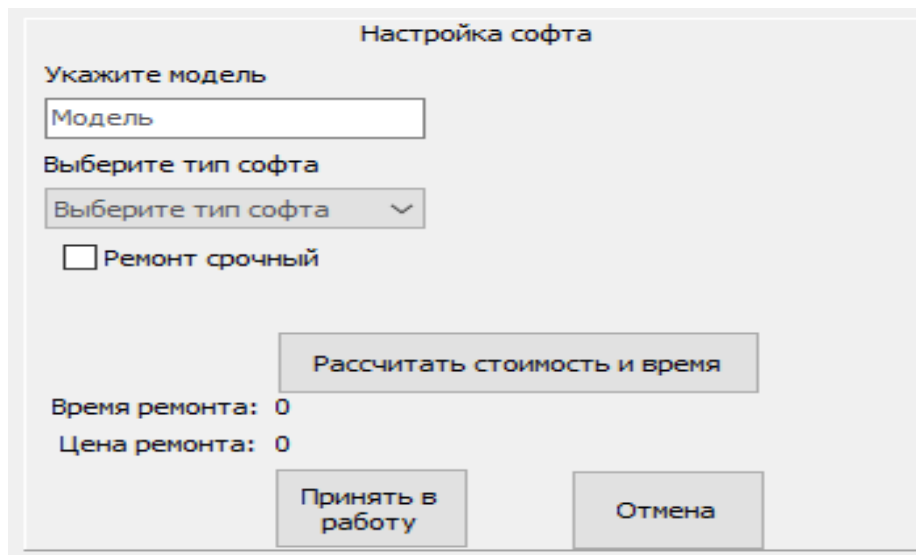
This form is primarily used by the Manager. But if necessary, the administrator also has access to it. The form allows you to accept an order from the client to send it further to the masters. When filling out this form, you must select a client. If the client came to the service center for the first time and their data is not yet in the database, then you need to add the client by clicking the appropriate button. After selecting all the open fields, either the hardware repair field or the software maintenance field opens, depending on the type of service you selected.



The screenshot shows a form titled "Ремонт техники" (Equipment Repair). At the top, it says "Укажите модель" (Specify model) and has a text input field with the placeholder "Введите модель техники" (Enter equipment model). Below that is a dropdown menu labeled "Выберите тип ремонта" (Select repair type) with "Выберите тип ремонта" (Select repair type) selected. Underneath the dropdown is a checkbox labeled "Ремонт срочный" (Urgent repair). In the center of the form is a button labeled "Рассчитать стоимость и время" (Calculate cost and time). At the bottom left, there are two labels: "Время ремонта: 0" (Repair time: 0) and "Цена ремонта: 0" (Repair cost: 0). At the bottom right, there are two buttons: "Принять в работу" (Accept for work) and "Отмена" (Cancel).

Picture 21 - Request panel for repair of equipment

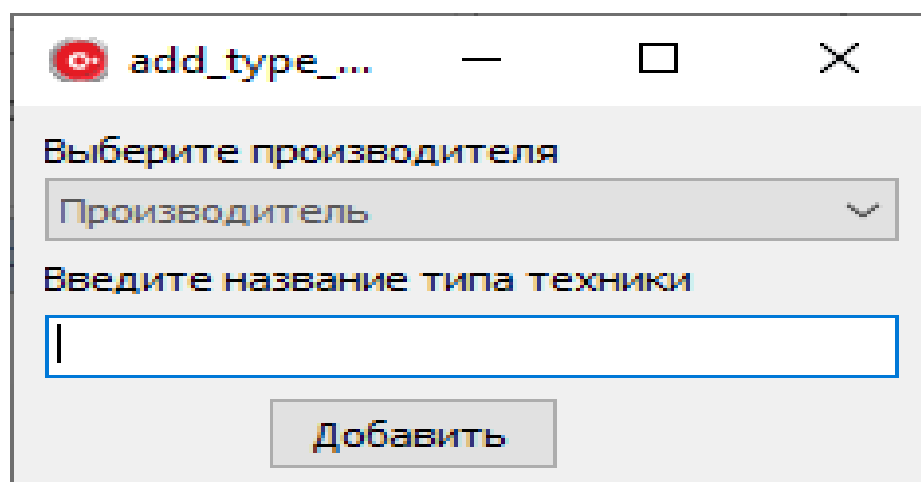
The urgent repair checkbox is necessary for the masters to understand that this order must be completed first. But this choice increases the cost of the order twice. After filling in all the fields and clicking on the calculate cost and time button, the approximate working time and cost will be displayed in the corresponding columns. After that, you can either accept the order or cancel it. When an order is accepted, data about it will be recorded in the orders table with the order is pending mark. If the software maintenance view was selected, then a different panel will be displayed.



Picture 22 - Software configuration request Panel

The principle of working with this panel is similar to the previous one.

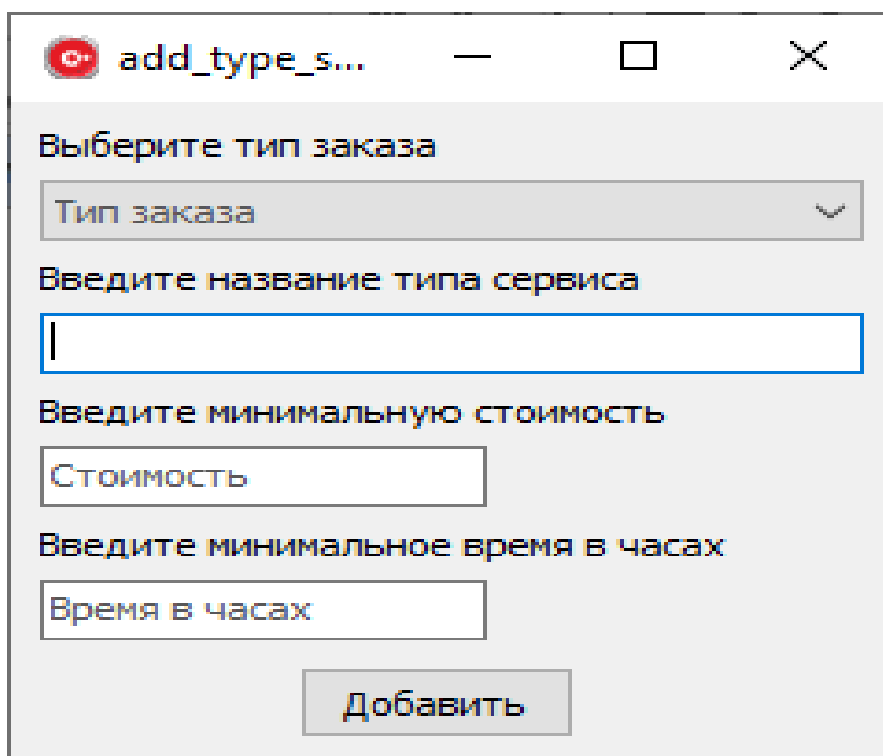
The added type of equipment button opens a form for adding a new type of equipment, which allows you to enter information about the new type of equipment that the service center will work within the database.



Picture 23 - Form for adding a type of equipment

After clicking the add button, information about the new type of equipment will be recorded in the database for further work.

The add service type button opens a form for registering a new type of service provided in the service center.



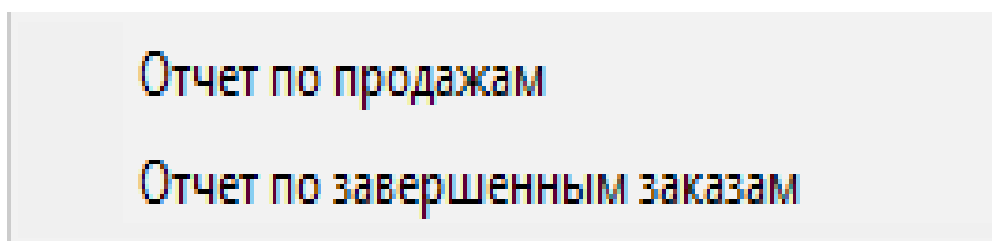
The screenshot shows a standard Windows window with the title 'add_type_s...'. The window contains the following elements:

- A dropdown menu labeled 'Выберите тип заказа' with the text 'Тип заказа' and a downward arrow.
- A text input field labeled 'Введите название типа сервиса' which is currently empty.
- A text input field labeled 'Введите минимальную стоимость' containing the text 'Стоимость'.
- A text input field labeled 'Введите минимальное время в часах' containing the text 'Время в часах'.
- A button labeled 'Добавить' at the bottom center.

Picture 24 - Form for adding a service type

When adding a new service type, you must select the order type: hardware repair or SOFTWARE configuration. Then specify the minimum cost and the minimum time in hours. Minimum cost – the price for specifying the service if it is not urgent. Minimum time in hours – how long it will take to provide the service if it is urgent. When specifying the minimum time, you should make a small margin, as it may happen that all the masters will be busy working.

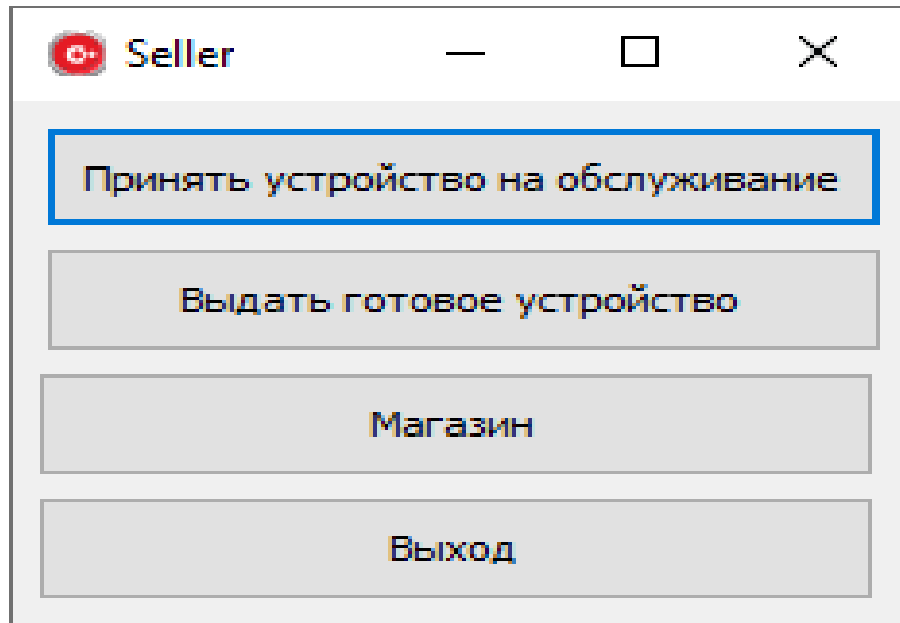
When you open the reports menu item, you will be offered a choice of implemented reports. At the moment, this is a report on all orders and a report on all sales.



Picture 25 – Reports

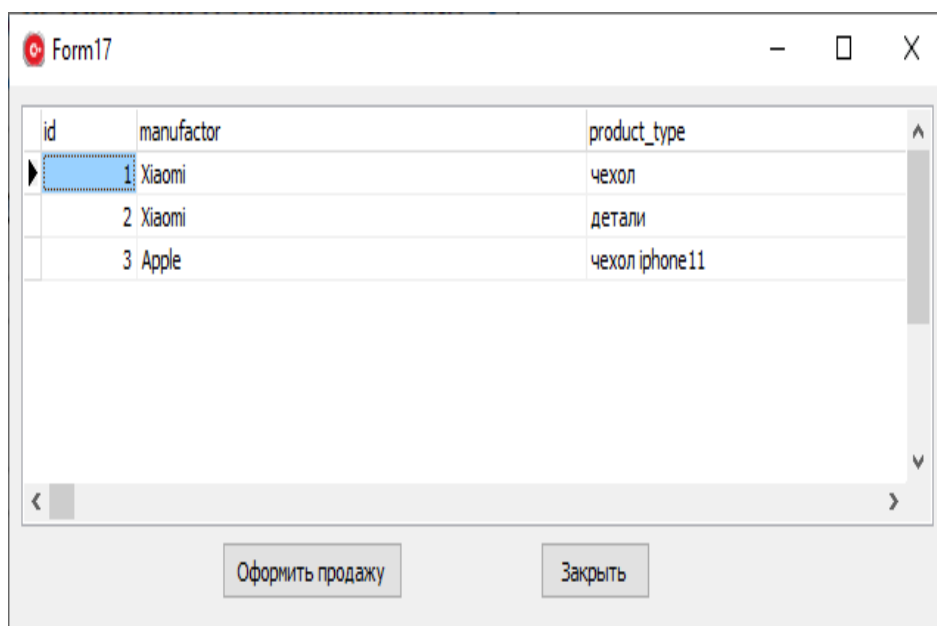
Each of these items opens the corresponding report. Screenshots of the report are located in the app.

The work of the sales Manager was also automated. When logging in, the employee is redirected to the Manager's form.



Picture 26 - Form the seller

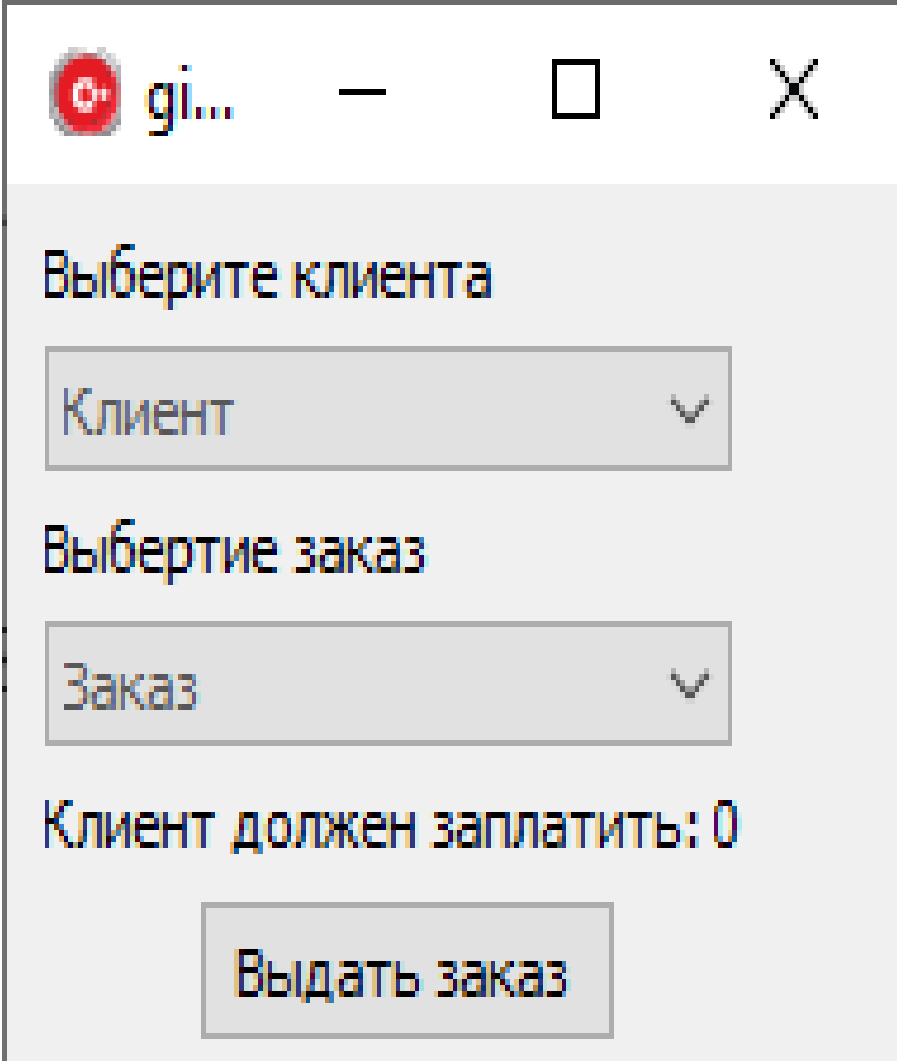
Clicking the accept device for the service button opens the order form that was reviewed earlier. When you click the store button, the store form opens.



Picture 27 - Form store

This form contains a DBGrid element that shows the current status of the store and information about products. The issue of a sale button opens the window for adding a sale that was discussed earlier.

When you click the issue device button, a form opens that allows you to issue the device to the customer and complete the order.



The image shows a software window titled "gi...". Inside the window, there are two dropdown menus. The first is labeled "Выберите клиента" (Select customer) and has "Клиент" (Customer) selected. The second is labeled "Выберите заказ" (Select order) and has "Заказ" (Order) selected. Below these menus, the text "Клиент должен заплатить: 0" (Customer must pay: 0) is displayed. At the bottom of the window is a button labeled "Выдать заказ" (Issue order).

Picture 28 - The form of the issuance of the order

In this form, the Manager must select the customer who came for their order and the order that was completed, after which the corresponding field will indicate how much the customer must pay. After the customer pays for the order, the Manager clicks the issue order button. The information will be entered in all the relevant tables, and the customer will need to go to the warehouse where they will be given the order.

When logging in as a master, the user is redirected to the form for working with orders.

Picture 29 - The form wizard

Using this form, the wizard can view all available orders, select an order, and start working on it. The master also sees what orders are currently in the process. The wizard can work on multiple orders simultaneously. When you finish working on the device, the wizard should change the status to completed. If necessary, the wizard can also set a different device processing status.

Picture 30 - Storekeeper's form

Using this form, the storekeeper can see which products are running out of stock. This table includes products if their quantity is less than 5. the Storekeeper can select the required order by manufacturer and product name and specify the quantity of the ordered product, add the item to the request. After that, the order will also be displayed in the lower table. When the product arrives at the storeroom, the storekeeper must select the request and click accept to the storeroom. After that, the product will be removed from the request and the quantity of the received product will be added to the product in the storeroom.

Conclusions on the section.

This section describes the stages of developing an automated information system for a service center. First of all, the activity of the center was studied to formulate models of business processes occurring in the company. Then, using information about the current state of business processes, and how management would like to see business processes after the introduction of the information system, the service center's business processes were restructured and a business process model was developed as it should be. The study and comparison of business process models as is and as should be has shown that the introduction of an information system can significantly improve the company's performance, as well as reduce time and money costs.

The next step after the restructuring of business processes and deciding on the need to implement an information system was the development of a database. After studying the information collected in the first paragraph, a diagram of the database structure was developed. After its approval and approval by management, a physical database with tables was created using SQL. The primary information needed for debugging the software package was also entered into the database.

After developing and configuring the database, the software package development stage began.

Describes the development of the user interface. Screenshots of the user interface are provided, and the functionality of each form is described. Specifically, it describes the functionality of forms for storekeeper, Manager, wizard, and administrator.

The most interesting lines of code are described. The functionality that they perform, as well as the functionality of methods written specifically for this commercial application.

The implementation of this system has significantly reduced the time for preparing documents and conducting the company's main processes, as well as reducing costs by reducing the number of man-hours spent.

After the development of all modules of the information system, they were tested and prepared for implementation.

3 The experimental part

3.1 System testing

After writing the system, the software package was tested. Minor errors in the program's code and logic were identified and fixed. For example, there is a problem with correct calculations of economic formulas when selling a product at a discount. Tests were also conducted on live users to find vulnerabilities in the program. Text fields were identified where it was possible to enter invalid information. For example, in the phone field, enter any characters other than numbers and signs, brackets. These vulnerabilities have been identified and resolved.

3.2 User guide

The program is launched by double-clicking on the Project1. EXE file. Then the authorization window opens. The user must enter their username and password and confirm that they are not a robot. Initially, the system has a username and password for the administrator, which grants rights to users.

The administrator can view all the information contained in the database, edit it, add new information, delete unnecessary information, and view reports on the activities of the service center.

At the top of the form is a drop-down menu consisting of three items: selecting a database, adding data, and reports. Clicking on the select database menu item opens a drop-down list containing a set of buttons, each of which changes the database displayed on the main form.

The add data drop-down menu contains a set of buttons that allow you to enter data correctly into the database. When you click on these buttons, the corresponding form for adding data opens. After entering the data and clicking the save button, the new form will close.

You can also add data directly to the table. To do this, select the required table, then click the plus icon located below the table. A new field will appear where you need to enter information and then click on the checkmark. This method is not recommended because most tables have fields that can take strictly defined values, and when adding them directly, a person may make an error in these values.

To delete a field, select the desired field in the table with the left mouse button and click on the minus sign. To edit information, double-click the cell of interest in the table with the left mouse button, then change the information, and then click the checkmark icon.

To view reports, select the report you are interested in and the corresponding form opens.

The seller sells products, as well as accepting and issuing orders to customers. After authorization, the user will be redirected to their work form. Where there are 3 buttons: store; issue a ready-made device; accept the device for service.

To sell a product, click the store button with the left mouse button. A form opens that displays information about the current state of the store and information about products. To make a sale, click the make a sale button. To view hidden information in the table, you can scroll through the slider at the bottom of the table by holding it with the left mouse button. To return to the previous menu you must click on the close button.

When you click on the proceed to checkout button will open a registration form sale. This form allows you to register the sale of an item in the program to get reports and monitor the condition of the warehouse. You must fill in all the drop-down lists one by one. The first list containing information about manufacturers that the service center works with is filled in automatically when creating the form. All subsequent lists are filled in after the previous one is activated. When you enter all the data, the program itself will calculate how much the specified amount of the selected product will cost. After all the data is entered, the user needs to click on the issue of a sale button.

To register a customer's order, click the accept device for the service button on the seller's form. There will be a form of registration of the order. When filling out this form, you must select a client. If the client came to the service center for the first time and their data is not yet in the database, then you need to add the client by clicking the appropriate button. After selecting all the open fields, either the hardware repair field or the SOFTWARE maintenance field opens, depending on the type of service you selected.

If you selected the repair of equipment, the corresponding form opens. All fields must be filled in. The urgent repair checkbox is necessary for the masters to understand that this order must be completed first. But this choice increases the cost of the order twice. After filling in all the fields, click the calculate cost and time button, then the corresponding columns will display the approximate working time and cost. After that, you can either accept the order or cancel it. When an order is accepted, data about it will be recorded in the orders table with the order is pending mark. If the SOFTWARE maintenance view was selected, then a different panel will be shown with the same operating principle.

To issue a ready order to the customer, the user must click the issue ready device button. On the form that opens, select the desired customer and the desired order, and then click the issue order button.

The storekeeper must accept a new product to the warehouse, form a purchase request, and check the warehouse so that the product does not end there.

After authorization, the user will be redirected to their form. Using this form, the storekeeper can see which products are running out of stock. This table includes products if their quantity is less than 5. the Storekeeper can select the required order by manufacturer and product name and specify the quantity of the ordered product, add the item to the request. To do this, select the manufacturer, then select the

product and enter the quantity of the ordered product. Then click the button and the order will also be displayed in the lower table. When the product arrives at the warehouse, the storekeeper must select the request and click accept to the storeroom. After that, the product will be removed from the request and the quantity of the received product will be added to the product in the storeroom.

The master is engaged in repairing and configuring equipment. Thanks to the program, the master can see all available orders, select an order, and start working on it. The master also sees what orders are currently in the process. The master can work on multiple orders simultaneously.

To accept an order for work, select an order in the corresponding list and click the accept order for the work button. The order will appear in the lower table. When changing the order status, left-click the order in the lower table, then select the desired status in the status list and click change status.

3.3 Suggestions for expanding the system

The developed modular information system covers as much of the company's activity as possible. But all the same, the development of the software package failed to affect all the company's activities. In the future, the service center module can be supplemented with a delivery function, as well as a mailing function for customers.

In the store module, you can increase the amount of work with finances, add a mail and phone module for direct communication with customers and suppliers, and develop an integration function with 1C and similar accounting systems.

Also add the online store module, as well as add the function of managing social networks and creating announcements in them that will attract a large audience of users of social networks such as VK, Instagram, etc.

Conclusions on the section

In the third section of the WRC, the system tests were described, user instructions were described, and suggestions were made for further upgrading the system.

All tests were passed successfully, the errors found were studied and corrected. The final test was to pass the program to inexperienced users.

The user manual has been prepared and tested on various types of users, including those who are far from working with computers. All types of users quickly got used to the program thanks to the user's instructions.

According to the proposals for modernization it is clear that the program can be significantly expanded which will lead to higher profits and a shorter payback period.

4 The economic part

Companies usually spend a large amount of money on the development and subsequent implementation of a new information system. Most often, companies do not have a specialist of the necessary level for developing an information system, and they have to either hire a contractor or use the services of a third-party company specializing in software development. Accordingly, the company's management has a question about the profitability of the information system. To describe the profitability of an information system, the calculation of economic efficiency is used. In essence, the economic efficiency of an information system is often not only and not so much in bringing profit, but in improving the quality of the enterprise and saving time resources.

Thanks to the introduction of an automated information system, it was possible to solve the problem of errors in documents caused by the human factor. However, it should be noted that if errors made in the formation of documentation for the service center, for the most part, will only cost time to correct them, then errors in the store's documents can cause financial damage, for example, lost profit due to not purchased goods on time, or loss of goods due to incorrect prices or receipt documents. The information system allows you to avoid these errors. Software modules also allow management to collect various reporting information, which can be used to make a plan for further quality improvement.

The economic part of this diploma project will provide a feasibility study for the development of an information system for the service center.

The FS (feasibility study) is used to determine the feasibility of creating a product, in this case, a software product.

The feasibility study consists of analyzing the cost of creating a software product, calculating the price of the software product itself, operating costs, as well as analyzing and calculating the results of creating and using a software product.

4.1 Complexity of information system development

To accurately determine the complexity of software development, it is necessary to divide the entire task into simpler stages. This will allow you to effectively monitor the progress of software development by dividing a complex task into easier subtasks. This approach, from my point of view, is considered more effective and allows you to efficiently and quickly process subtasks. The distribution model of software development complexity and development stage is shown in chart3.

Chart3 - software development stages

Stages of developing	Type of work	Labor intensity, person per hour.
1 st stage	Statement of problem	20
2 nd stage	Development and approval of T3 for software development	30
3 rd stage	Search and study of similar programs	15
4 th stage	Search and study of related literature	20
5 th stage	Creating analytical software charts	15
6 th stage	Registration of the theoretical part of the thesis	25
7 th stage	Development of the practical part of the diploma project	20
8 th stage	Project implementation	50
9 th stage	Debugging and Trouble shooting issues	20
10 th stage	Organizing the report and results	15
11 th stage	Software OS testing	30
12 th stage	Summary of the developed software	10
13 th stage	Integration	25
Total:Complexity of project execution		295

The working day is 8 hours long. As a result, it takes 37 business days to implement the software.

4.2 Calculating software development costs

Determining the costs required for software development is based on the available estimates, which include the following elements:

- material costs;
- the cost of labor;
- social tax;
- depreciation of fixed assets;
- other expenses.

Material costs are divided into basic and auxiliary costs for materials, energy, and other costs necessary for software development. Material costs are calculated using the form shown in table 4.

Chart 4- Expenditure on material resources

Name of the material	Brand	Unit of measurement	Quantity	Price for unit in tenge	Amount in tenge
Office paper	Svetocopy	Pack	3	1200	3600
Copybook (96 sheets)	ErichCrause	Stuff	2	200	400
Notebook	ErichCrause	Stuff	2	450	900
Pens	Maxriter	Stuff	2	200	400
Computer mouse	Logitech	Stuff	1	3000	3000
Total:					8 300

The Asus Vivo Book s330UN laptop will be used for software development. the laptop's power is sufficient to perform the tasks set. Because the laptop contains the installed operating system and software necessary for SOFTWARE development, there is no need to make additional expenses for new OS and SOFTWARE.

The total amount required for material assets (Z_M) can be calculated using the following formula:

$$Z_M = \sum P_i * C_i, (1)$$

where P_i is the consumption of the i-th type of material resource, natural units;
 C_i - price per unit of the i-th type of material resource, tg.

i - type of material resource;

n - the number of types of material resources.

The calculation of costs for the necessary hardware and software is made in the form shown in chart5.

Chart 5 - Calculation of costs for equipment and software required for the project

Name of the material	Brand	Unit of measurement	Quantity	Price for unit in tenge	Amount in tenge
Laptop	AsusVivoBookS330UN	Stuff	1	396000	396000
Printer	Samsung SCX-3400	Stuff	1	58000	58000
Modem	TP-LINK TD	Stuff	1	17 000	17 000
OS	Windows 10	Stuff	1	-	-
Total:					471000

$$E_{e.s} = 8004 \text{ (tenge)} \quad (2)$$

For additional requirements, expenses are calculated based on an increased indicator of 5% of electricity costs:

$$E_{ad.req} = 5\% * E_{e.s}, \quad (3)$$

Determine the cost of additional needs according to the formula (4.4):

$$E_{ad.req} = 0.05 * 8004 = 400,2 \text{ (tenge)} \quad (4)$$

Based on all calculations, the total cost of electricity is:

$$= 400,2 + 8004 = 8404,2 \text{ (tenge)} \quad (5)$$

4.3 Calculation of labor costs

Software development, as mentioned earlier, requires two employees:

- project Manager – time management, workflow adjustment, coordination, subject area study;
- developer – software development, testing, and maintenance.

The number of labor costs can be calculated using the following formula:

$$E_{c.md} = \sum CH_i * T_i \quad (6)$$

where CH_i is the hourly rate of the i -th employee, Tg;

T_i is the complexity of the model design, person.×h; i is the category of the employee;

n - the number of employees involved in the development of the inventory item.

During the implementation of the project, the working time of participants is uneven, so it makes sense to set the hourly rate of each employee, and the total amount of wages.

The employee's hourly rate can be calculated using the following formula:

$$CH_i = \frac{MS_i}{MFW_i} \quad (7)$$

where MS_i is the monthly salary of the i -th employee, tg;

MFW_i is monthly fund of working time of the i -th employee, hour.

The monthly salary of the manager is 190,000 tenge and the monthly salary of the developer is 160,000 tenge. Calculate the hourly rate of each employee according to the formula (4.6):

$$HR_{\text{manager}} = \frac{190\,000}{22*8} = 1\,079,54 \text{ tg/h} \quad (9)$$

$$HR_{\text{developer}} = \frac{160\,000}{22*8} = 909,09 \frac{\text{tg}}{\text{h}} \quad (10)$$

The hourly rate of the manager is 1 079.54 (tg / h), the labor intensity of development is equal to 100 hours. The developer's hourly rate is 909.09 (tg / h), and the development time is 295 hours. According to the formula (4.5), you can calculate the number of expenses for employees' wages:

$$E_{tp} = 1079,54 * 100 + 909,09 * 295 = 107954 + 268181 = 376\,135 \quad (11)$$

Calculations of labor costs are shown in chart (6).

Chart 6– Calculation of wages

Employee category	Qualification	The complexity of the development OS, hour	Hourly rate, Tg / h	The amount, tg.
Manager	Project Manager	100	1079,54	107954
Developer	Programmer	225	909,09	318181
Total:				426 135

4.4 Calculation of social tax expenses

According to the Tax Code of the Republic of Kazakhstan, social tax is 9.5% of the payroll. Taxes paid for employees by a legal entity can be calculated using the following formula:

Chart 7- Taxes paid for employees by a legal entity

Taxes paid by a legal entity	10,46	FOT	426 135
SSC (Social security contributions)	3,5	(MS - OPB)*3,5%	13 423,25
BOCMC (Deductions for BOCMC)	2,0	MS*2%	8 522,70
ST (socialtax)	9,5	(MS - OPB - BOCMCY)*9,5% - CO	22 606,46
Total taxes paid			44 552,41

The calculation results are shown in the chart (8):

Chart 8-Accrual of social contributions and taxes

Employee category	Number of employees	Salary, tg	Social security contributions and taxes, tg
Manager	1	107954	11 286,59
Developer	1	318181	33 265,82
Total:			44 552,41

4.5 Depreciation of fixed assets and other expenses

The depreciation rates of the OF must be determined in accordance with the tax code of the Republic of Kazakhstan. The depreciation of the OF can be determined by the following formula:

$$A_g = \frac{C_{ce} * D_r}{100} (12)$$

где, $C_{c.e}$ – cost of equipment;

H_r – depreciation rate (depreciation rate = 25);

Formula (4.8) allows us to calculate the desired amount for depreciation charges for a year for a laptop:

$$A_g = \frac{300\,000 * 25}{100} = 75\,000 \text{ tenge} \quad (13)$$

Now we need to calculate the depreciation rate for the development period:

$$A_g = \frac{62500 * 34}{365} = 6986,3 \text{ tenge} \quad (14)$$

Similarly, we have to calculate the depreciation rate for all equipment. The calculation results are shown in table (9).

Chart9 –AmortizationOF

Name of equipment and type of software	Cost of hardware and software , tg	Annual amortization rate, %	The amount of amortization	Amount of amortization during development, tg
Laptop	300 000	25	75 000	6986,3
Printer	58000	25	14500	1350,57
Modem	17 000	20	2 800	316,6
Total:			92 300	8652,07

Scientific trips are not provided.

Expenses under the item "other expenses" for specific software include the cost of purchasing and preparing special scientific and technical information and special literature. They are determined according to the standard developed by the organization as a whole, as a percentage of the basic salary:

$$P_{3i} = C_{oi} \cdot \frac{N_{oe}}{100} \quad (15)$$

where S_{oe} is the norm standard of other expenses in the whole organization in (%), in the thesis you need to take 20%.

$$P_{3i} = 318181 \cdot 0,2 = 63\,636,2 \text{ tenge} \quad (16)$$

The cost of the article "Overhead" (P_{ni}), connected with necessity of maintenance of control of the subsidiary farms and experienced (experimental) productions, as well as costs for General needs (P_{ni}), are time-specific according to the norm (N_{np}) as a percentage of the basic salary of the performers. The standard is set for the entire organization:

$$P_{3i} = C_{oi} \cdot \frac{N_{np}}{100} \quad (17)$$

where P_{ni} - overhead costs for specific software (thousand tenge);
 H_{HP} - the standard of overhead expenses in the whole organization in (%), in the thesis you need to take 70%.

$$P_{hi} = 318181 \cdot 0,7 = 222\,726,7 \text{ tenge} \quad (18)$$

Cost estimates for SOFTWARE development.

Based on all the presented calculations, it is necessary to issue an estimate of software development costs following the form shown in the chart (10). The picture shows a diagram of operating expenses.

Chart10 – Cost estimates for software development

Cost items	Сумма, тг
Equipment costs	471000
Expenditure on material resources	8300
The cost of the software	0
The cost of labor	426135
Social tax	44552,41
Energy costs	8004
Amortization of fixed assets	6986,3
Other costs	63636,2
Overhead cost	222726,7
Total for the estimate:	1251340,61

4.6 Determination of the possible (contractual) price FOR

The cost of software is determined based on the quality of the developed product, the timing of its development, and the performance of the product. The cost of C_d for software can be calculated using the following formula

$$C_d = S_n \left(1 + \frac{P}{100} \right), \quad (19)$$

where S_n – the cost of software development, tg;

P – the average level of software profitability, (%). this parameter is assumed to be 40%.

$$C_d = 1251340,61 \left(1 + \frac{40}{100} \right) = 1\,751\,876,9 \text{ tenge} \quad (20)$$

Then we have to determine the cost of sales including VAT, the VAT rate is set by the legislation of the Republic of Kazakhstan. For 2019, the VAT rate is

12%. The cost of sales including VAT can be calculated using the following formula:

$$C_p = C_d + C_d * VAT, \quad (21)$$

$$C_p = 1\,751\,876,9 + 1\,751\,876,9 * 0,121\,962\,102,1 \text{ tenge} \quad (22)$$

The developer participates in the development of the SOFTWARE and bears the corresponding costs, for which an estimate is made, paid by the customer under the agreement. Development costs are determined by the standard ($H_O=10\%$) of the software cost per 3 months and are calculated using the formula:

$$P_{Oi} = C_{ni} \cdot \frac{H_O}{100} = 1251340,61 \cdot 0,1 = 125\,134 \text{ tenge} \quad (23)$$

Software maintenance costs (P_{Ci}). The developer organization provides SOFTWARE maintenance and bears the corresponding costs, which are paid by the customer in accordance with the contract and the estimate for maintenance. Maintenance costs are determined by the established standard ($H_C=20\%$) of the cost of software (per year) and are calculated using the formula:

$$P_{Ci} = C_{ni} \cdot \frac{H_C}{100} = 1251340,61 \cdot 0,2 = 250\,268 \text{ tenge} \quad (24)$$

Software investment including development and maintenance costs will be:

$$K = 1\,962\,102,1 + 125\,134 + 250\,268 = 2\,337\,504,311 \text{ tenge} \quad (25)$$

This price may be rounded up to 2 337 505 tenge.

4.7 Calculation of savings due to increased labor productivity

The introduction of an information system in the office does not imply the reduction of employees. The information system is being implemented to increase labor productivity.

Chart 11 –User activity

Posotoin	Type of work	Before automation min., F_j	After automation min., F_j	Time saving, min., ΔT_j	Increased productivity P_i , %
Manager	Registration of applications	5	4	3	25
	Issuing an application	3,3	2,9	1,7	14
	Implementation of sales	2,3	2,2	1,3	5

Master	Acceptance	1	0,9	0,5	11
	Completion of the order	1,2	1,14	0,5	5

To calculate the savings due to increased productivity, you need to compare the time spent by users on implementing certain processes before implementing the IP and the time that is planned to be spent on implementing the same processes after implementing the IP. This comparison is shown in the chart 11.

The savings associated with increased user productivity are determined by the formula (11).

$$\Delta P = Z_s \times \sum_i P_i / 100 \quad (26)$$

The manager's annual salary, together with social contributions, is:

$$S_p = (250\,000 + (250\,000 \times 10,46\%)) \times 12 = 3\,313\,800 \text{ tg.} \quad (27)$$

The annual salary of the master, together with social contributions, per year is:

$$S_{as} = (250\,000 + (250\,000 \times 10,46\%)) \times 12 = 3\,313\,800 \text{ tg.} \quad (28)$$

$$S_{as} = 3\,313\,800 \times 4 = 13\,255\,200 \text{ tg} \quad (29)$$

The savings for the Manager per year is:

$$\Delta P_t = 3\,313\,800 \times (25 + 14 + 5) / 100 = 1\,458\,072 \text{ tg.} \quad (30)$$

The savings for design engineers per year is:

$$\Delta P_{ip} = 13\,255\,200 \times (11 + 5) / 100 = 2\,120\,832 \text{ tg.} \quad (31)$$

$$\Delta P = \Delta P_t + \Delta P_{ip} = 1\,458\,072 + 2\,120\,832 = 3\,578\,904 \text{ tg.} \quad (32)$$

So, the savings associated with increased productivity of users amounted to 2,783,572 tenge per year.

4.8 Evaluating the effectiveness of implementing an information system

It is important to note that the implementation of the information system does not imply additional costs. Implementation occurs by installing the program by the programmer-developer on the users' personal computers. The information system will be supported by the service center administrator.

Operating costs will include the annual depreciation of fixed assets and the annual cost of machine time.

The annual cost of machine time to solve the problem is determined by the formula (4.7):

$$S_m = K \times q \times 12 \quad (33)$$

where K is the number of hours of PC usage per month;
 q -cost of an hour of machine time (146 tenge / hour) [9].

Taking into account the 8 hour working day, as well as 21 working days per month, we get the PC usage hours per month $K=168$ hours. Based on this it will turn out:

$$S_m = 168 \times 146 \times 12 = 294\,336 \text{ tg.} \quad (34)$$

Depreciation of fixed assets for the year 2020 was 278 639 Tg. So, the total operating costs will be:

$$OC = 278\,639 + 294\,336 = 572\,975 \text{tg.} \quad (35)$$

Annual cash savings will be equal according to the calculation:

$$3\,598\,904 - 572\,975 = 3\,025\,929 \text{ tenge} \quad (36)$$

We will also determine the total benefits of implementing the software product.

Technical and economic indicators allow us to rationally determine the feasibility of SOFTWARE development and installation, as well as to weigh the real benefits of the company, both for the system developer and for its user.

We can also determine the payback period of the software in months, according to the formula:

$$P_{ok} = 12 \cdot \frac{C_{development}}{E_{peryear}} \quad (37)$$

where P is the payback period in months;
 C_{devel} is development costs of the program;
 $C_{peryear}$ is annual savings.

$$P_{develop.} = 12 \cdot \frac{2\,337\,505}{3\,025\,929} = 12 \cdot 0,77 = 9,3 \text{ month.} \quad (38)$$

Anticipating the annual product benefit and annual operating costs with the introduction of software, you can determine the efficiency coefficient (C) using the formula:

The calculated coefficient of economic efficiency of capital investments is:

$$E_n = \frac{E_{cr.}}{K} \quad (39)$$

$$E_n = \frac{E_{cr}}{C} = \frac{3\,025\,929}{2\,337\,505} = 1,3 \quad (40)$$

The efficiency coefficient indicates the ratio of tenge saved and spent. In conclusion, we can say with confidence that 1 spent tenge accounts for 1.3 tenge of profit.

Chart 12 - Indicators of comparative economic efficiency from the implementation of the software product

Name of indicators	Significance
Conditional annual cost savings, tenge	3 025 929
Coefficient of economic efficiency of capital investments (Ep)	1,3
Payback period for capital investments (Tr)	9,3 month

Implementation of this software product in the enterprise workflow brings cost savings and automation of the workflow. Installing this software package allows you to reduce the number of employees, which consequently reduces the cost of paying taxes, salaries and other monetary expenses. Accordingly, the volume of technical equipment, depreciation charges and electricity costs will decrease. The software package profitably automates the process, making it easier for staff to work and increasing their efficiency, besides reducing the company's expenses.

Expected annual economic effect amounted to 3 025 929 tenge. The app will pay for itself in the first 9.3 months of use.

Conclusions on the section. In the fourth section, the part of economic efficiency of implementing the software package was calculated.

When calculating economic efficiency, it can be seen that although the information system itself does not bring actual income, and in its essence is a cost, the increase in labor productivity due to the introduction of an information system, as well as the coverage of a new consumer sector, more than pays for the cost of developing and implementing an information system.

5 Life Safety part

The diploma project on the topic "Development of an order accounting application for a service center" is dedicated to the development of a mobile application on the Android platform, which will be an excellent tool for permanent access to the public service center.

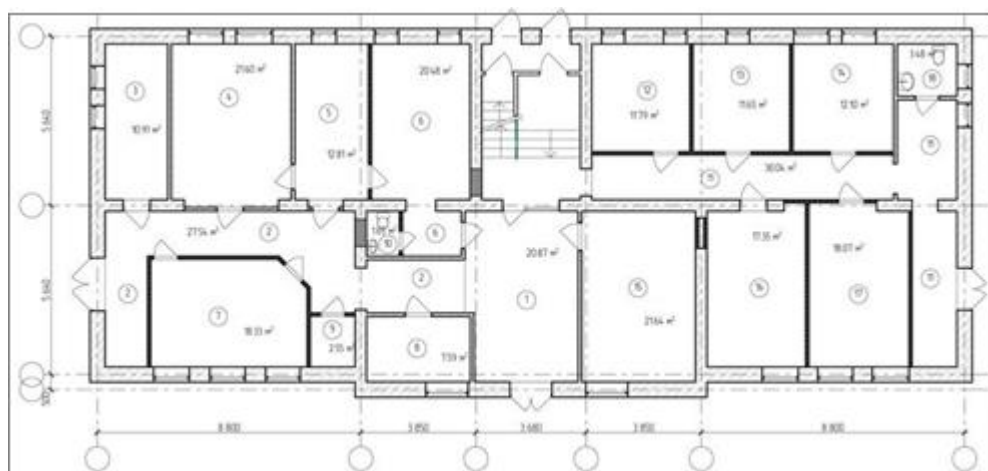
Today, many people use smartphones, almost all of their lives are connected with using the phone.

5.1 Analysis of dangerous and harmful production factors when working with computers

Employees of the public service center are exposed to these physiologically dangerous and harmful industrial factors, such as increased noise, increased ambient temperature, low or insufficient illumination of the work area, electric current, static electricity, and others.

Almost all employees of the center are connected with the influence of such psychophysical causes as mental overstrain, overstrain of visual and auditory analyzers, the monotony of work, emotional overload. The impact of these not very favorable reasons leads to a decrease in performance, caused by developing fatigue. The appearance and formation of fatigue are associated with changes that occur during work in the Central nervous system, with inhibitory actions in the cerebral cortex.

The ground floor plan of PSC is shown below.



Picture 31 - Diagram of the first floor of the PSC

Medical examinations of VC employees have shown that in addition to reducing labor productivity, the highest noise levels lead to hearing loss. A long stay of a person in the zone of combined exposure to various not very favorable

reasons can lead to occupational disease. Analysis of injuries among employees indicates that most accidents occur from exposure to physically dangerous industrial causes when employees perform uncharacteristic work.

Thus, the environmental factors that affect service center employees and software developers are the same, since they are associated with working at computers, and therefore we will analyze them in the following sequence. It should be noted that the employees of PSC during the period of submission of accounting documents of individual entrepreneurs, LLP, etc. are overloaded with people and in this regard, my work is relevant.

The programmer's work belongs to the category of work Ia, which includes work with an energy intensity of up to 120 kcal/h (up to 139 W), performed while sitting and accompanied by minor physical stress. The optimal microclimate parameters for this category of work are shown in the table below.

Chart13 - The optimum parameters of microclimate in the room

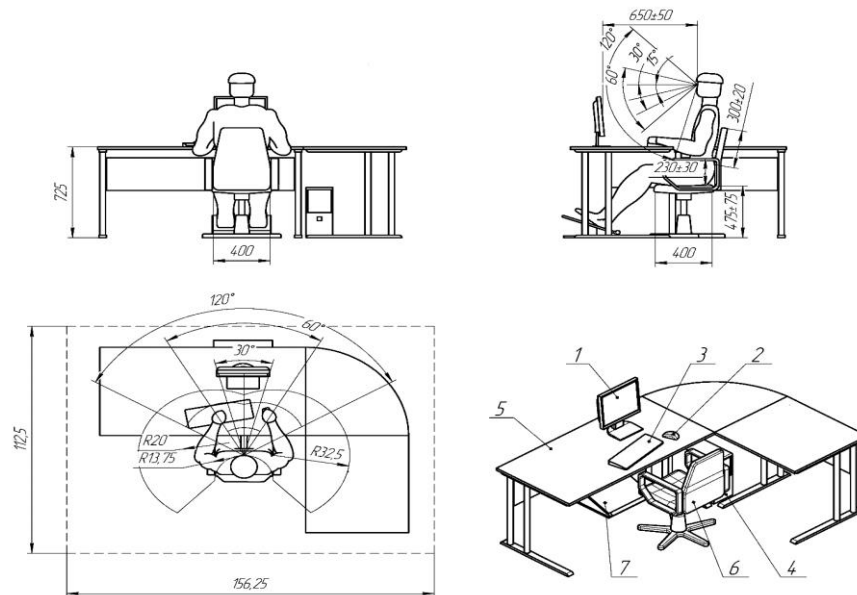
Name of parameters and unit of measurement	In cold time	In hot time
Temperature, °C	20...22	22...25
Relative humidity, %	30...60	30...60
The speed of air movement, m/c	No more than 0.2	No more than 0.5

Measures to improve the air environment in the production premises include: in the warm season, air conditioning is used to remove excess heat and moisture, and in the cold season, a Central heating system is introduced.

In our room temperature: in winter $t=20 \dots 21 \text{ }^\circ\text{C}$; in summer- $t=23\dots24 \text{ }^\circ\text{C}$. Humidity 55%, air speed - 0.2 m/s. This data meets the standards.

5.2 Placement and safe operation of process equipment

The working area and the mutual placement of all its elements must correspond to anthropometric, physical, and psychological conditions. When organizing a programmer's workplace, it is desirable to observe these basic conditions: the best placement of equipment that is part of the workplace and a sufficient working area that allows you to carry out all the necessary movements and movements.



Picture 32 - Ergonomic parameters of the workplace

The main elements of the workplace of employees are a table and a chair. The main working position is the sitting position.

The working sitting position causes minimal fatigue for the programmer. The rational layout of the workplace provides for a clear order and consistency of placement of items, labor tools, and documentation. What you need to do more often is located within easy reach of the workspace.

The optimal placement of work items and documentation in zones should be within reach.

5.3 Ensuring electrical safety

Electric current is a hidden type of hazard because it is difficult to detect in current-and non-current-carrying parts of equipment that are good conductors of electricity. A current that exceeds 0.05 A is considered to be deadly to human life, and a current less than 0.05 A is safe (up to 1000 V). To prevent electric shock, only persons who have thoroughly studied the basic safety rules should be allowed to work.

Depending on the category of premises, certain measures must be taken to ensure sufficient electrical safety during the operation and repair of electrical equipment.

In the premises of discharge currents of static electricity are most likely to arise when touching any of the elements of the computer. Such discharges do not pose a danger to humans, but in addition to unpleasant sensations, they can lead to computer failure. To reduce the amount of static electricity generated, the coating of technological floors should be made of single-layer polyvinyl chloride antistatic

linoleum. Another method of protection is to neutralize the charge of static electricity with ionized gas. Radioactive neutralizers are widely used in the industry. General measures of protection against static electricity in the VC include General and local air humidification.

5.4 Provision of standard illumination

The computer room should have natural and artificial lighting. Fatigue of the visual organs depends on some reasons: insufficient illumination; excessive illumination; incorrect light direction.

The calculation of room illumination is reduced to choosing the lighting system, determining the necessary number of lamps, their type, and location.

Artificial lighting is performed using two types of electric light sources: incandescent and fluorescent lamps. We will use fluorescent lamps, which in comparison with incandescent lamps have significant advantages:

- the spectral composition of light they are close to daylight, natural light;
- have higher efficiency (1.5-2 times higher than the efficiency of incandescent lamps);
- have an increased light output (3-4 times higher than that of incandescent lamps);
- longer service life.

Lighting is calculated for a room of 30 m², which is 5 m wide and 3.5 m high. Let's use the light flux method.

To determine the number of lamps, we determine the light flux falling on the surface using the formula:

$$F = \frac{E * K * S * Z}{n}, \quad (5.4.1)$$

where F is the calculated luminous flux, LM;

E – normalized minimum illumination, LX (determined by the table). The programmer's work, following this table, can be classified as accurate work, therefore, the minimum illumination will be E = 400 Lux;

S – the area of the illuminated room (in our case, S = 30 m²);

Z is the ratio of average to minimum illumination (usually taken as 1.1-1.2, let Z = 1.1);

K – the reserve coefficient, which takes into account the decrease in the light flux of the lamp as a result of contamination of lamps during operation (its value is determined by the table of reserve coefficients for various rooms and in our case, K = 1.5);

n – utilization rate (expressed as a ratio of the luminous flux falling to the surface, to the total flux of all lamps and is calculated as a fraction; depends on the characteristics of the lamp, the size of the room, painting the walls and ceiling,

characterized by coefficients of reflection from the walls (W) and ceiling (C)), the value of the coefficients RS and RP define the table of the dependence of the reflectance from the nature of the surface: $P_w=30\%$, $P_c=50\%$.

The value of n is determined by the table of coefficients of use of various lamps. To do this, calculate the index of the room using the formula:

$$I = \frac{S}{h*(A+B)}, \quad (5.4.2)$$

where S is the area of the room, $S = 30 \text{ m}^2$;

h-calculated suspension height, $h = 3.2 \text{ m}$;

A – width of the room, $A = 5 \text{ m}$;

B-length of the room, $B = 6 \text{ m}$.

Substituting the values we get:

$$I = \frac{30}{3.2*(5+6)} = 0.85 \quad (5.4.3)$$

The power of the lighting system P is determined from the expression:

$$P = n * N * P_i, \quad (5.4.4)$$

where P_i is the power consumption of one lamp, kW.

Usually for light rooms of computer halls $GP = 70\%$, $GS = 50\%$, $gr = 30\%$.

Knowing the room index I, PC and RP, we find $n = 0.32$

Substitute all the values in the formula for determining the light flux F:

$$F = \frac{400*1.5*30*1.1}{0.32} = 61875 \text{ Лм} \quad (5.5.5)$$

For lighting, choose fluorescent lamps of the type LB40-1, the luminous flux of which is $F = 4220 \text{ Lux}$.

Calculate the required number of lamps using the formula:

$$N = F/F_l, \quad (5.4.6)$$

where N is the defined number of lamps;

F-luminous flux, $F = 63642.857 \text{ LM}$;

F_l - luminous flux of the lamp, $F_l = 4220 \text{ LM}$.

$$N = \frac{61875}{4220} = 14.66 \approx 15 \text{st.} \quad (5.4.7)$$

Power of the lighting system:

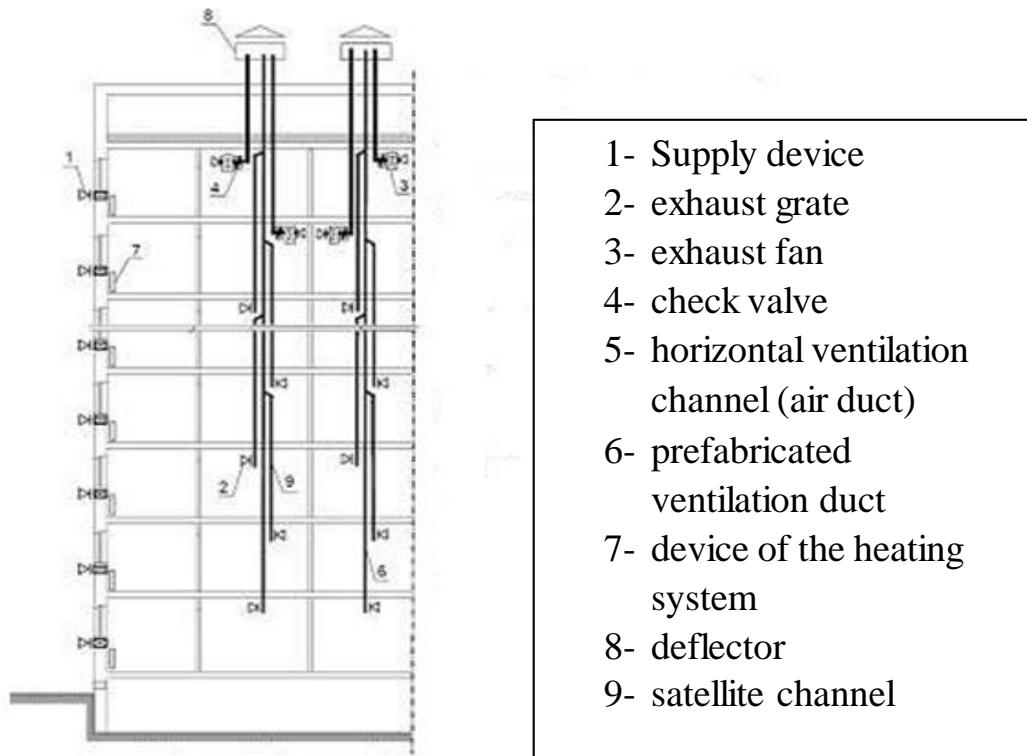
$$P = 2 * 12 * 0,04 = 1,2 \text{ kW.} \quad (5.4.8)$$

When choosing lighting devices, we use lamps of the OD type. Each lamp is equipped with two lamps. Lamps are placed in two rows, four in each row.

6 Calculation of aspiration systems

If there is a large crowd of people in a closed room such as a PSC on the first floor during the submission of reports, when entering Universities or in similar conditions, it is necessary not only to ventilate but also to organize the operation of air conditioners and ventilation through a ventilation shaft. This is because natural ventilation is not able to cope with a large number of people in a confined space.

The calculation of air conditioning and ventilation systems is based on determining the heat gain from solar radiation through glazing, people, lighting devices, office equipment and equipment, as a result of temperature differences, as well as determining the heat stress of the air in the room.



Picture 33 - The structure of ventilation shafts

Source data:

- 1) Room parameters: length L - 40m, width B - 40m, height H - 4m.
- 2) Equipment data: number of units-6; total installation capacity, N_y kW, efficiency factor -0.8%.
- 3) Data on the light source: $N_o = 40 \text{ W} / \text{m}^2$ - power os.y., n - the number of lamps in the lamp 8, type of light source-fluorescent lamps.
- 4) Number of employees: men-5.
- 5) Windows: number-5; area of one window- 4m^2 (L_{window} and B_{window} -2m), view-plastic binding.
- 6) The Parameters B.
- 7) Estimated time-13-14 hours.

8) Indoor temperature: in summer, $t_b + 25\text{C}$; in winter, $t_n - 18\text{C}$.

Type of work position-sitting;

1) Calculated geographical latitude-44C.sh. Almaty.

2) Heat flows from direct and scattered radiation are taken for the estimated hour of the day, as indicated above in the source data. They depend on the geographical latitude and will be equal to $q^I = 271 \text{ W/m}^2$, $q^{II} = 87 \text{ W/m}^2$.

3) β - coefficient of heat transmission, depends on the characteristics of external and internal sun protection devices. In our case, β is equal to 0.8 dark fabric sunscreens.

4) K_1 -coefficient of darkening of glazing by bindings (K_1^i - for irradiated openings, K_1^s for openings in the shade). Because I have glass blocks, I'm going to use values for openings with solar irradiation from the methodology in the corresponding chart. K_1 -0.7.

5) K_2 - the coefficient of glazing fouling is equal to 0.95 for glasses with a slight contamination.

6.1 Heat gain and heat loss as a result of temperature differences

The amount of heat Q_{og} is determined by the formula:

$$Q_{og} = V_r \cdot X_0 \cdot (t_v - t_v), \quad (6.1.1)$$

Where t_v is the indoor temperature in winter

t_v -outdoor air temperature

V_r - volume of the room (the product of the length, width, and height of the room are set or inserted from the data for production rooms)

X_0 - specific heat characteristic equal to $0.42 \text{ W/M}^3 \text{ }^\circ\text{C}$

So, we substitute the values and get that in the warm period of the year, Q_{og} because in the warm period of the year approximately the temperature outside the room is equal to the temperature inside:

$$Q_{og} = 40 \cdot 40 \cdot 4 \cdot 0,42 \cdot (25-25) = 0\text{W} \quad (6.1.2)$$

for a cold period of time:

$$Q_{og \text{ winter}} = 40 \cdot 40 \cdot 4 \cdot 0,42 \cdot (18 - (-25)) = 115 \quad (6.1.3)$$

584W

$18 \text{ }^\circ\text{C}$ is the actual indoor temperature in the winter period of the year (the indoor temperature in the cold period of the year varies from 18 to $23 \text{ }^\circ\text{C}$). The choice of outdoor temperature in cold weather is made either by SNiP or by the actual average values of the current year.

6.2 Heat access from solar radiation through the glazing

The excess heat of solar radiation, depending on the type of glass, is almost 90% absorbed by the room environment, the rest is reflected. The maximum thermal load is achieved at the maximum level of radiation, which has direct and scattered components. Parameters A and B are set according to the RGR options.

The heat gain from solar radiation (radiation) is determined by the formula:

$$Q_p = m \cdot F \cdot (q^I + q^{II}) \cdot \beta \cdot K_1 \cdot K_2 \quad (6.2.1)$$

where m is the number of windows in the room;

F – window area, m^2 (product of the length and width of the window opening $F = L_{\text{window}} \cdot B_{\text{window}}$);

q^I, q^{II} - heat flows from direct and scattered radiation W / m^2 , taken for the estimated hour of the day, depending on the geographical latitude are equal.

β - coefficient of heat transmission, depends on the characteristics of external and internal sun protection devices (in source data, 0.8)

K_1 - coefficient of glazing darkening by bindings (in source data, 0.7)

K_2 - coefficient of glazing thickening (in source data, 0.95)

$$Q_p = m \cdot F \cdot (q^I + q^{II}) \cdot \beta \cdot K_1 \cdot K_2 \quad (6.2.2)$$

$$Q_p = 5 \cdot 4 \cdot (271 + 87) \cdot 0,8 \cdot 0,7 \cdot 0,95 = 3809,12 \text{ W}, \text{ или } 3,8 \text{ kW} \quad (6.2.3)$$

6.3 The heat availability from people

The heat availability of people depends on the intensity of the work performed and the parameters of the surrounding air. The heat released by a person consists of tangible (explicit), i.e. transmitted to the air of the room by convection and radiation, and latent heat spent on the evaporation of moisture from the surface of the skin and the lungs.

It should be noted that it is considered that a woman allocates 85% of the normal heat output of an adult man.

The release of obvious heat by people in the room will be:

$$q_l^u = n \cdot q_{ahf} \quad (6.3.1)$$

where q_{ahf} is the apparent heat from a person (at a temperature of -18°C in a sitting position, employees will have a total heat output of 115 W, and at an ambient temperature of $+25-61$ W).

Then, according to the conditions, 6 men and 4 women work in our premises and during the summer period, the heat generated by people will be:

During the warm season:

$$Q_{s \text{ summer}}^u = 5 \cdot 61 = 305 \text{ W} \quad (6.3.2)$$

During the cold season:

$$Q_{w \text{ winter}}^u = 5 \cdot 115 = 575 \text{ W} \quad (6.3.3)$$

From the table there are no values of the temperature in summer equal to 25°C , so we take 26°C and the sitting position according to the conditions of the problem. However, the most accurate results will be when finding the average arithmetic sum of the temperature of 24 and 26°C . Although the release of heat from people is specific, because the anatomy and physiology leaves an imprint on the amount of radiated heat from a particular person. Also for winter time there are no values

-10°C , then we take the lowest value of 10°C and the position is also sitting.

7 Heat access from lighting devices

Heat release from lamps is determined by the formula:

$$Q_{\text{light}} = \eta \cdot N_{\text{lp}} \cdot F_p \cdot n, \text{ W} \quad (7.1)$$

Where η is the coefficient of conversion of electrical energy to thermal energy. When using incandescent lamps, $\eta=0.92\div 0.97$; for fluorescent lamps, $\eta=0.5-0.6$. the Light load must be set.

N_{lp} – lamp power, for good indoor lighting, W/m^2 . When preliminary calculations for well-lit rooms can be taken $N_{\text{lp}}= 50-100 \text{ W/m}^2$, but we have a task of 40 W/m^2

F_p – floor area (length-20m; width-15m).

n – the number of lamps in the luminaire is 8 st.

Total:

$$Q_{\text{light}} = 0,5 \cdot 40 \cdot 300 \cdot 8 = 48000 \text{ W или } 48 \text{ kW} \quad (7.2)$$

7.1 Heat generated by production equipment

It is defined by the formula:

$$Q_{\text{oq}} = N_s \cdot K \cdot n \cdot \eta_{\text{CoE}}, \text{ W} \quad (7.1.1)$$

Where N_s is the power consumed by the equipment, kW;

n – number of hardware;

K – coefficient of installation capacity of the equipment in dano or according to the SNIIP. For example, the total installed power of electric motors for hydraulic presses, pumps, etc. is 90 kW. For machine-building plants $K=0.25$.

Coefficient of efficiency = 0.8%

$$Q_{\text{oq}} = 2000 \cdot 0,25 \cdot 6 \cdot 0,8 = 2400 \text{ W или } 2,4 \text{ kW} \quad (7.1.2)$$

7.2 Heat generated by office equipment

Heat flows that occur due to office equipment located in the room, on average, 240 W is taken per 1 computer in full configuration or 30% of the power of the equipment.

So we either take 240 W or about

$$Q_{\text{oq}} = 2400 \text{ W} = 100\% \quad (7.2.1)$$

$Q_{ogtech} = 30\%$, then it turns out 720 W
(7.2.2)

7.3 Heat balance in the room

Thus, we need to calculate the heat balance for the summer and winter periods separately.

Let's determine the heat balance in the room.:

$$Q_i = Q_{og} + Q_p + Q_l + Q_{oc} + Q_{qb} + Q_{ogtech} \quad (7.3.1)$$

$$Q_i = Q_{og} + Q_{ou} + Q_l + Q_{oc} + Q_{qb} + Q_{ogtech} \quad (7.3.2)$$

during the warm season:

$$Q_{og\ summer} = Q_{og\ summer} + Q_p + Q_{l\ summer} + Q_{oc} + Q_l + Q_{gtech} \quad (7.3.3)$$

$$Q_{og\ summer} = 0 + 3809,12 + 305 + 48000 + 2400 + 720 = 55234,12\text{W или } 55,2\text{ kW} \quad (7.3.4)$$

during the cold season:

$$Q_{og\ winter} = Q_{og\ summer} + Q_p + Q_{l\ summer} + Q_{oc} + Q_l + Q_{gtech} - Q_{og\ summer} \quad (7.3.4)$$

$$Q_{og\ winter} = 3809,12 + 575 + 48000 + 2400 + 720 - 115584 = -60079,88\text{ W или } -60\text{ kW} \quad (7.3.5)$$

Note that when calculating the heat balance in the cold period of the year, it is necessary to sum up all the heat received, but subtract the heat loss as a result of the temperature difference inside and outside the room, because the heat goes out of the room beyond its limits.

We calculate the heat stress of the air by the formula:

$$Q_s = Q_{og} \cdot 860 / V_n \quad (7.3.6)$$

$$Q_s = \frac{Q_{og} \cdot 860}{V_n} \quad (7.3.7)$$

Given that $t_{Q_{og\ sum}} > Q_{og\ win}$, we will use Q_{og} for the flight period for the calculation:

To do this, find the volume of the room with its existing parameters V_n length-40m · height-4m, $V_n = 6400\text{m}$

$$Q_s = 55,2 \cdot 860 / 6400 = 7,4\text{ kcal/m}^3 \quad (7.3.8)$$

Conditions:

$$\leq 20 \text{ kcal/m}^3, \text{ to } \Delta t = 6^\circ\text{C} \quad (7.3.9)$$

$$Q_s \geq 20 \text{ kcal/m}^3, \text{ to } \Delta t = 8^\circ\text{C} \quad (7.3.10)$$

Compare our values

$$Q_s = 7,4 \text{ kcal/m}^3 \leq 20 \text{ kcal/m}^3, \text{ to } \Delta t = 6^\circ\text{C} \quad (7.3.11)$$

The amount of heat required for air to enter the room:

$$L = Q_s \cdot 860 / C \cdot \Delta t \cdot \gamma \quad (7.3.12)$$

where C is the heat capacity of the air, 1,005 kcal/kg°C;

Δt -select the dependence on the heat stress of the air Q_s

γ -specific mass of supply air, 1,204 kg /m³

The air conditioner is selected based on the main technical characteristics of Internet sources.

So, we choose the model of the Amico air conditioner of the SDA series with an air flow of 4970 m³/h. The main technical parameters of this air conditioner: cooling 20.1 kW, compressor power 5.2 kW, weight 260 kg, with dimensions height=1740 mm, depth=1200 mm, width=450 mm.

Output by section:

So, after completing this section, I learned how to analyze the working conditions at the programmer's workplace, describing the main environmental factors that affect it. Thus, the main production factors of the environment are: radiation, electric current, temperature, humidity in the room, fresh air and noise.

Due to the fact that the work of an IT specialist is similar to the activity in the price, the most important condition for employees during the period of mass gatherings of people in the premises of their professional activities is the creation of air conditioning. Therefore, in the calculation part of this section, I tried to find the optimal air conditioner that would cope with air cooling in the volume of 4904 m³/h. This air conditioner was SDA with an air flow of 4970 m³/h.

Conclusion. In this final qualification work, a prototype of an information system for a service center for digital equipment maintenance was developed. During the implementation, a full-fledged automated information system was created, consisting of four automated jobs: the administrator's place; the storekeeper's place; the master's place; the Manager's place. This information system covers all the main activities of the service center.

Modern programming languages and software development technologies were studied during the development of the information system. The service center information system was designed in C++ in the Embarcadero XE8 programming

environment using the Fast Report library. The SQL query language was also used to work with the database.

A relational database was created with functions for storing, deleting, editing and adding the necessary information. The created program also protects incorrect information input.

The software package has passed all tests and is ready for implementation. The developed information system successfully solves all the tasks. The productivity of employees and the quality of processed information has increased many times.

Based on the above, we can conclude that the created information system of the service center for the maintenance of digital equipment significantly increases the company's profit, is not only self-sustaining but also fully profitable. Also, it is worth noting that this system is very popular not only among service centers for servicing digital equipment but, with a small change, in other service centers. In the future, it is planned to implement the product introduction to other companies in this industry.

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Addition A

Profit report on sales and orders

Form19

id	type_order	type_tech	manufactor
1	Ремонт техники	Смартфон	Xiaomi
2	Ремонт техники	Смартфон	Xiaomi

Прибыль составила: 20000

Form19

id	type_sale	name_sales	count_prod	total_price	profit	p
1	продажа	чехол mi6	1	1000	500	a
2	продажа	чехол mi6	1	1000	500	a
3	продажа	чехол mi6	1	1000	500	a

Прибыль составила: 1500