Вінницький національний технічний університет
_____
(повне найменування вищого навчального закладу)

Факультет інтелектуальних інформаційних технологій та автоматизації
_____
(найменування структурного підрозділу)

Кафедра автоматизації та інтелектуальних інформаційних технологій
_____
(найменування випускової кафедри)

Пояснювальна записка

до магістерської кваліфікаційної роботи
на тему «Development of the intelligent module "Tags about batch and containers"
for automated printing of tags in the "PlasmIS" ERP system»

<div align="right">

Виконав: студент 2 курсу,
групи 1АКІТ-21м
спеціальності
151– «Автоматизація та комп'ютерно–
інтегровані технології»
(шифр і назва напрямку підготовки, спеціальності)

Старжинський В.Ю.
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Рецензент: к.т.н., доц.Арсенюк І.Р.
(прізвище та ініціали)

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Вінниця ВНТУ – 2022

Vinnytsia National Technical University
_____
(full name of university)

Faculty of Intelligent information technologiesand automation
_____
(full name of institution, name of Faculty (Department))

Department of Automation and Intelligent Information Technologies
_____
(full name of the department(subject, framing Commission))

Thesis

ToMaster'squalifyingpaperonthetopic«Development of the intelligent module "Tags about batch and containers" for automated printing of tags in the "PlasmIS" ERP system»

Performed by: student2^{nd} course,
1ACIT-21m group
specialty
151– «Automation and Computer Integrated Technologies»
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VinnytsiaVNTU – 2022

Вінницький національний технічний університет

Факультет інтелектуальних інформаційних технологійта автоматизації

Кафедра автоматизації та інтелектуальних інформаційних технологій

Освітньо-кваліфікаційний рівень:магістр

Спеціальність:151– «Автоматизація та комп'ютерно–інтегровані технології»

Освітньо-професійна програма: Інтелектуальні комп'ютерні системи

ЗАТВЕРДЖУЮ

Завідувач кафедри АІІТ,

_____ д.т.н., проф. О.В. Бісікало

"__" _____ 2022 р.

ЗАВДАННЯ

НА МАГІСТЕРСЬКУ КВАЛІФІКАЦІЙНУ РОБОТУ СТУДЕНТУ

Старжинському Валерію Юрійовичу

1. Тема магістерської кваліфікаційної роботи: «Developmentoftheintelligentmodule "Tagsaboutbatchandcontainers" forautomatedprintingoftagsinthe "PlasmIS" ERPsystem»,керівникмагістерської кваліфікаційної роботи:

БісікалоО. В.,к.т.н., проф. каф. АІІТ

затверджені наказом закладу вищої освіти від "__"_____2022 року №__

2. Строк подання студентом МКР _____

3. Вихідні дані до роботи:
  – методологічна та технологічна сумісність інтелектуального модуля здіючоюна підприємстві ПрАТ "ПлазмаТек"ERP-системою "ПлазмІС";
  – модель бази знань – система продукцій;
  – автоматизація друкубірок для будь-яких комбінацій виробничих даних;
  – технологічні засоби для програмної реалізації модуля – JavaScript, jQuery,Oracle APEX.

4. Зміст розрахунково-пояснювальної записки (перелік питань, які потрібно розробити):
  – 1Аналіз стану та технологій розробки ERP систем.
  – 2Технології розробки модуля "Бірки партія-тара".
  – 3 Розробка моделей автоматизованого друку бірок.
  – 4 Розробка програмного забезпечення модуля друку.

5. Перелік графічного матеріалу (з точним зазначенням обов'язкових креслень):
  – загальна структура інформаційного модуля "Бірки партія-тара";

– діаграма варіантів використання;

– діаграма діяльності для користувацької частини;

– діаграма діяльності для серверної частини;

– діаграма послідовностей процесів;

– загальний вигляд інтерфейсу модуля;

– вигляд вікон редагування, друку та додавання.

6. Консультанти розділів МКР

Розділ	Прізвище, ініціали та посада консультанта	Підпис, дата	
		завдання видав	завдання прийняв
4	Козловський В.О., к.е.н., проф.каф. ЕПВМ		
1,2,3,5	Бісікало О. В.,д.т.н., проф. каф. АІІТ		

7. Дата видачі завдання_____

КАЛЕНДАРНИЙ ПЛАН

№ з/п	Назва етапів МКР	Строк виконання етапів роботи	Примітка
1	Аналіз предметної області ERP систем		
2	Порівняльний аналіз технологій для розробкимодуля"Бірки партія-тара"		
3	Розробка моделей автоматизованого друку		
4	Реалізація процесів додавання, редагування та видалення даних		
5	Програмна реалізація друку бірок		
6	Економічна частина		
7	Оформлення матеріалів до захисту МКР		

Студент   _____   СтаржинськийВ. Ю.

Керівник роботи   _____   БісікалоО. В.

Рецензент   _____   Арсенюк І.Р.

Vinnytsia National Technical University
_____
(full name of university)
Faculty of intelligent information technologies and automation
Department of Automation and Intelligent Information Technologies
Education and qualification level:Master
Specialty:151– «Automation and Computer Integrated Technologies»
Educational and professional program: Intelligent computer systems

APPROVED
HeadoftheAIIT department,
DrSc., Prof.O. Bisikalo

_____
" __ " _____ 2022

TASK
AT THE MASTER'S QUALIFICATION WORK STUDENT

StarzhynskyiValerii
(firstname, surname)

1. Theme of the master's qualification work«Development of the intelligent module "Tags about batch and containers" for automated printing of tags in the "PlasmIS" ERP system» supervisior:
BisikaloOleh,DrSc., professor
(surname, firstname, academic degree, academic title)
approved by the order of the higher educational institution from" __ "_____2022 № __

2. The term of submission by the student of master's qualification work
_____

3. Initial data for master's qualification work:
  - methodological and technological compatibility of the intelligent module with the "PlasmIS" ERP system operating at the PJSC "PlasmaTek" enterprise;
  - knowledge base model – product system;
  - automation of label printing for any combination of production data;
  - technological tools for software implementation of the module – JavaScript, jQuery, Oracle APEX.

4. Contents of the explanatory note (list of questions to be developed):
  1. Analysis of the state and technologies of development of ERP systems.
  2. Technologies for the development of the "Batch-container tags" module.
  3. Development of automated label printing models.

4. Development of print module software.

5. List of graphic material (with exact indication of mandatory drawings):
   – the general structure of the " Tags about batch and containers " information module;
   – diagram of use cases;
   – process sequence diagram;
   – general view of the module interface;
   – view of editing, printing and adding windows.

6. Consultants of chapters of master's qualification work

Section	Surname, Lastname	Signature, date	
		task issued	task accepted
4	Kozlovskyi V., Ph D., professor		
1,2,3,5	Bisikalo O., Ph D., professor		

7. Date of issue of the assignment_____

Schedule

№	The name of the stages works	The duration of the stages of work	Note
1	Analysis of the subject area		
2	Overview of the problems of creating the " Tags about batch and containers" module		
3	Module development		
4	Economic part		
5	Implementation of label printing		
6	Development of processes for adding, editing and deleting data		
7	Preparation of materials for the defense of the Master's work		

Student   _____   Starzhynskyi V.

Supervisor   _____   BisikaloO.

Reviewer   _____   ArseniukI.

АНОТАЦІЯ

В даній магістерській кваліфікаційній роботі розроблено інтелектуальний модуль для ведення складського обліку та прийняття технологічно обумовленої сировини на склад підприємства. Програмна реалізація модуля виконана з використанням таких технологій, як OracleAPEX, JavaScript, Pl/SQL тощо. В роботі представлено створені інтерфейс модуля та частину взаємодії із базою даних, реалізовано процес редагування та додавання даних. Розраховано витрати на розробку та проведено оцінку економічного ефекту від можливого впровадження запропонованої системи.

ANNOTATION

In this master's qualification work, an intelligent module was developed for keeping warehouse records and accepting technologically conditioned raw materials into the company's warehouse. The software implementation of the module is made using such technologies as Oracle APEX, JavaScript, Pl/SQL, etc. The work presents the created interface of the module and part of the interaction with the database, the process of editing and adding data is implemented. The development costs were calculated and the economic effect of the possible implementation of the proposed system was assessed.

CONTENT

INTRODUCTION

Relevance. Over the past 20 years, business applications and programs have evolved from management information systems to enterprise information systems that offer decision support for enterprise resource planning. Enterprise resource planning is an activity that includes procurement, production, project, human resources, finance and provides accurate real-time data to help managers or executives make informed and effective decisions. The purpose of such planning is to organize information flows between all business processes within the enterprise and to effectively manage all its divisions for the entire set of functions and tasks.

The rapid development of information technologies of data storage, communications and processing allows storing and processing all information in cyberspace.

Enterprise Resource Planning software attempts to integrate all manufacturing and service departments with their inherent functions into a single intelligent computer system to address the various problems and meet the diverse needs of these departments.

Implementing a single system that meets the needs of different departments (for example, finance, warehouse, HR) is a difficult task, as these departments have individual software that is designed and optimized according to the work of each department. However, if implemented correctly, this integrated approach can be very effective for an enterprise from an economic opinion. Based on a single ERP information system, different departments can easily exchange data and information with each other.

Despite all the technological breakthroughs in this direction, there are numbers of tasks that global IT companies are currently working on, for example: scaling databases by size (up to petabytes), automating the design and administration of databases and ERP systems, automatic detection of data trends, structures and anomalies (data mining, data analysis, in particular intelligent, etc.). The task of creating separate modules within the existing ERP system of the enterprise is urgent,

which allows increasing the level of automation of certain types of work and, as a result, to achieve measurable economic advantages of the enterprise as a whole.

Purpose of the work. Updating the level of automation of label printing and accounting of relevant data through the development of the "Tags about batch and containers" module for the current "PlasmIS" information system.

Object of the study. At the PJSC "PlasmaTech" the processes of printing tags and recording the relevant data were chosen.

The subject of the study. JavaScript, jQuery programming technologies and tools, and Oracle APEX enterprise low-code development platform.

Research objectives:

1. Analysis of existing ERP systems.

2. Analysis of the work of individual departments of the PJSC "PlasmaTek" plant.

3. Development of models for automated accounting of production data and architecture of the "Batch-container tags" module.

4. Development of software and graphic support for the "Party-container labels" module.

Research methods: system analysis, methods of knowledge engineering, in particular, building a knowledge model based on the product system, analysis of business processes in production, object-oriented design, methods of client-server software development.

Scientific novelty. Consists in improving the system of printing tags and automating this process.It consists in improving the system of printing tags and automating this process. In particular, the model of the knowledge base of the production type of the "Batch-container labels" module has been improved, which consists of independent sets of production rules, predicates, functions and operators and, based on this, provides automated printing of labels for any combination of production data.

Testing of results of work:

1. The results of the work were considered at the LI Scientific and Technical Conference of Vinnytsia National Technical University in 2022 [1]

2. Theresultsoftheworkwereconsideredatthe LIScientificandTechnicalConferenceofVinnytsiaNationalTechnicalUniversity; DepartmentofAutomationandIntelligentInformation Technologiesin 2022 [20]

3. Theresultsoftheworkwereconsideredatthe 11th InternationalScientificandTechnicalConference "INFORMATION SYSTEMS AND TECHNOLOGIES IST-2022" at November 22-25, 2022. [28]

1 ANALYSIS OF THE RELEVANCE OF ERP SYSTEM DEVELOPMENT

1.1 General information about ERP systems

Enterprise resource planning ERP is a type of software that organizations or companies use to manage daily business activities: accounting, procurement, project management, risk management and compliance, delivery of various formats, etc. A complete ERP package also includes enterprise performance management, software that helps plan, budget, forecast, report on an organization's financial performance.

ERP systems integrate many processes and ensure the flow of data between them. By collecting an organization's common transactional data from multiple sources, ERP systems eliminate data duplication and ensure data integrity [1].

1.1.1 The history of the emergence of ERP systems

The history of ERP began over a hundred years ago. In 1913, engineer Ford Whitman Harris developed what was later called the optimal order quantity (EOQ) model. It is a production system based on paper documents, used for drawing up production schedules. For decades, the EOQ model has been the manufacturing standard. The first company to implement a material requirement planning (MRP) solution that combined EOQ concepts with the capabilities of using large computers was the instrument manufacturer Black & Decker (1964).

The MRP solution remained the standard for manufacturers until the manufacturing resource planning (MRP II) system was developed in 1983. The MRP II system included modules as the main architectural component of the software, as well as integrated basic manufacturing components such as purchasing, material cost rationing, scheduling, and contract management. For the first time in history, various production tasks were combined in a single system. The MRP II system provided companies with the ability to share and integrate data, as well as improve operational efficiency through better production planning, reduced inventory requirements and

waste. As computer technology developed in the 1970s and 1980s. Concepts similar to MRP II were developed for aspects of the business not directly related to production, such as finance, customer relationship management, and data for personnel management. By 1990, technical analysts coined the name of a new category of software for business management — enterprise resource planning (ERP)[2].

In the early 1980s, MRP systems expanded to become company-wide systems capable of handling not only material planning and control, but the planning and control of almost all of an organization's business processes. ERP systems began to gain popularity in 1994 when a German company released a system called SAP with the release of R/3 as the next generation software. In the following years, companies began to invest billions in ERP systems offered by SAP and other ERP system developers such as Oracle, JD Edwards, and Microsoft [22].

1.1.2 Component modules of ERP systems

ERP consists of a number of different modules and sets of functions tailored for different aspects of the business, involving different users and employees. Today advanced ERP systems are a serious multi-functional tool and not the usual reporting of financial and other fundamental functions as it was decades ago. The list of the most common ERP modules and sections includes:

- The financial module, the basis of every ERP system, which manages all financial transactions and data. Every transaction, financial transaction and financial reporting is tracked here;
- The procurement department manages the procurement of raw materials or finished products. It can automate requests for quotes and purchase orders, and when coupled with demand planning, minimizes overbuying and underbuying;

- The manufacturing module can be complex. This module helps companies coordinate all stages of product production. The module can ensure production according to demand and control the quantity of work-in-progress and finished products;

- The stock management module shows the current stock levels down to the SKU (Stock keeping unit) level and updates these figures in real time. It also measures key inventory-related metrics. Any product manufacturing company needs this module to optimize inventory based on current and forecasted demand;

- The order management module is an application that tracks and prioritizes customer orders from all channels as they arrive and tracks their delivery progress. An order management module can speed up lead and delivery times and improve customer interactions;

- In warehouse accounting, there is a process of managing warehouse operations, such as receiving, picking, packing, and shipping. Implementing such a module helps save time and money in the warehouse by identifying more efficient ways to perform these tasks;

- Customer Relationship Management (CRM) - management of relationships with customers. CRM is a popular module for businesses in many industries. It tracks all customer communications, helps lead management and can improve customer service and increase sales;

- Professional services automation (PSA) - automation of professional services. Service businesses often use a professional services automation (PSA) module to plan and track projects, including the time and resources spent on them. This can simplify invoicing to clients and encourage collaboration between employees working on a project;

- Workforce Management (WFM) - personnel management. The Workforce Management (WFM) module keeps track of attendance and hours worked,

and some can also manage payroll. This tool can record absenteeism and productivity of the department, team and individual employee;

– Human Resources Management (HRM) - personnel management. The human resources management (HRM) or human capital management (Human Capital Management HCM) module is similar to the workforce management module. It maintains employee records with detailed information such as available PTO and performance reviews, and can identify workforce trends across departments or demographics;

– The e-commerce module allows retailers and brands to manage the front and back of their online stores. They can change the look of the site and add and update product pages with this app.

– The marketing automation module manages marketing efforts across all digital channels—email, web, social—and enables organizations to optimize and personalize their messages. A marketing automation tool can increase leads, sales, and customer loyalty [3].

1.2 ERP tactical objectives

There are several reasons that compel businesses and companies to start working with ERP: the need to improve the efficiency of supplies; the need to expand customer access to products or services; the need to reduce operational costs; the need for a faster and more flexible response to the changing market; and the need to derive business intelligence from data over time. Developers or support should implement the following actions to achieve these goals:

Database consolidation. One of the most outstanding features of any ERP system is that it is built around a "super database," or an integrated, comprehensive data storage system that captures all of your company's operational data. Major ERP software packages transform your internal databases, typically system or department specific, into an interconnected conglomeration of thousands of database tables, more tightly integrated than before. Regardless of whether a new database platform is

being mastered, integrating tables across systems and across departments is a key step in mobilizing for ERP;

Integration of outdated programs with new developments. Most ERP software systems offer all the standard business systems as standard packages that you can use. But usually specific and outdated systems prevail, even if some new systems or applications have already been introduced. In this case, it is necessary to reconfigure the outdated software so that it works productively together with the new programs;

Implementation of information flow throughout the company. Legacy systems and applications have always split data into "master data" and "transactional data". The relationship between the two is simple: transactional data consists of master data (for example, a purchase order consists of customer information and product information). And master data in the past tended to belong to a specific department. In an ERP system, the relationship between master data and transactional data remains, but the "ownership" of the department disappears. Most internal users will have access to more master data and more transactional data than before, primarily for decision support processes;

Increasing access to data outside the company. It's not just about selling products or services over the Internet, it's about real-time data access between the company and partner companies, the cost-effectiveness of web services for distributed systems, and the convenience of web interfaces for remote and internal systems [4].

1.3 Development technologies of ERP systems.

ERP development is an umbrella term for a variety of enterprise resource planning software development services. Such software helps companies manage their finances, optimize production, supply chains, operations, reporting and other activities.

1.3.1 ERP software development process

The initial stage is the stage of clear understanding and clarification of the requirements for the information system. Any modules can be included in the web application, and it will be a great option for small and medium businesses. For a large corporation, you need to choose an ERP cloud. Good examples are S/4HANA SAP packages etc. In order to create a high-quality software product, it is necessary to consult with all interested parties and IT specialists of the company.

The next stage is the review and development of a user-friendly interface and design. The interface will include a lot of user roles, navigation elements, diagrams and interactive components. Therefore, the design should be the main one. If the application is intended for a large organization, it is necessary to involve users from different departments in the planning. Thus, the system will be more multifunctional and all-important functions and necessary modules will be taken.

The choice of technologies for implementation and creation of an ERP system is extremely important. For this, it is necessary to form the correct technical stack. For example, the most popular ERP development language is generic JavaScript. Its underlying frameworks are ideal for front-end development. And Node.js does a great job on the server side. SQL relational databases are suitable for small companies that need standardization. Non-relational or NoSQL is better suited for complex infrastructures because it allows data to be stored in easily manageable formats such as JSON.

The choice of technologies for implementation and creation of an ERP system is essential. For this, it is necessary to form the correct technical stack. For example, the most popular ERP development language is generic JavaScript. Basic frameworks are ideal for developing interfaces. And Node.js is a great tool for working with the server part. SQL relational databases are suitable for small companies that need standardization. Non-relational or NoSQL is better suited for complex infrastructures because it allows data to be stored in easily manageable formats such as JSON.

Usually, simple and intelligent ERP systems require the integration of third-party applications, such as Office 365, G Suite, FreshBooks, etc. Using a dedicated API, developers will be able to access them and display them in your system.

System hosting can be implemented in several ways: placing the system in a cloud environment or on a local server. The first option is more popular because it is considered safer and does not require regular internal maintenance.

A testing cycle is required to ensure that the product meets security, integration and functionality requirements, module functionality evaluation, security validation. It is also generally recommended to integrate dynamic testing with web application firewalls (WAFs) to monitor and respond to vulnerabilities as they occur [5].

1.3.2 Technological stack for ERP system software

The front-end technologies that are commonly used in the development of ERP system interfaces include:

- HTML is the basic building block that structures web content into sections, paragraphs, images, headings, links, and other blocks;
- CSS is a style sheet language that describes how web content looks on a website. With this tool, a developer can define text color, size and font, paragraph spacing, background color or design, images, table sizes, and other aspects of a web page;
- JavaScript is used to create additional user interface elements such as sliders, interactive maps, calculators, and 2D and 3D animations;
- React.js is a JavaScript library for developing dynamic and interactive user interface elements. Developers can use this library to design a single page user interface or an entire mobile application. Its purpose is to provide high speed, simplicity and scalability of front-end development;
- Angular.js is an excellent JavaScript framework supported by Google for building responsive and dynamic single-page applications;

– Vue.js is a progressive JavaScript framework for building user interfaces and complex single-page applications.

Back-end technologies for the development of ERP systems include:

– .NET is a platform for creating high-quality, cross-platform, high-performance and secure software; It allows you to use multiple languages (C#, F#, VB, etc.), editors, and libraries to create enterprise server applications running on Windows Server and Linux, or large-scale cloud microservices;

– Java is a server-side programming language;

– Python is a high-level programming language that is sometimes used to develop server-side solutions;

The following technologies are used to develop and implement the database:

– MSSQL is a popular management system from Microsoft for data storage and administration;

– PostgreSQL is an object-relational database management system used in custom solutions;

– Oracle SQL is one of the best alternatives to corporate database management programs;

– MongoDB is an open-source document-oriented NoSQL database management system that uses an unstructured query language;

– Azure CosmosDB – similar to MongoDB and SQL, easily supports ACID transactions, but does not use a relational data model[5].

1.4 Conclusions

Based on the analysis of modern ERP systems and their development technologies, a huge number of tools were determined, which are planned to be used

for the modification of the "PlasmIS" IS - a large multi-level ERP system that meets the requirements of the factories of the PlasmaTec group of companies. Based on the results of the comparative analysis, it is suggested to use the following technologies:

- For developing the server part of the module, it is recommended to use Oracle APEX (the main application for collecting the architecture of the module; all processes and procedures are stored here);

- For developing the server part, it is recommended to use the Pl/SQL programming language (development of the main process for requesting data from the database; development of filter processes; development of processes related to printing labels, etc.);

- For developing the user part of the module, it is recommended to use the JavaScript programming language (development of the interface, the main grid (tables for data output), editing and adding windows, etc.).

2 DEVELOPMENT TECHNOLOGIES OF THE "TAGS ABOUT BATCH AND CONTAINERS" MODULE

2.1 Justification of the choice of technologies for the development of the server part

2.1.1 Oracle APEX

The "PlasmIS" information system is an active information portal based on Oracle Application Express.

Oracle Application Express is a low-code development platform that allows you to create scalable, secure, and feature-rich enterprise web applications. The created programs can be further deployed on different sites.

Oracle Corporation's APEX software product is designed to design, develop, and deploy functional, user-friendly, responsive database-interacting applications using a web browser only. Oracle Application Express is a free add-on to Oracle Database. With APEX software, you can create complex web applications that can run on most modern web browsers.

Key capabilities of Oracle APEX:
- Data visualization. The platform allows you to quickly search and filter data with faceted search, build into the application the ability to create controlled user reports, and use large tools for building interactive graphs during development;
- Conversion of program spreadsheets. The system allows you to create working programs from electronic spreadsheets used in business. Unlike spreadsheets, APEX provides access to a single, centralized application where everyone stores and always sees the same data;
- Ready to use programs. The delivery includes fully functional and ready-to-use components designed to meet the most popular requirements and cover workflows;

- Expandable applications. Ready-made applications built on Oracle Application Express can be extended and further customized to meet individual business needs;

- Fast REST API assembly. The platform has a convenient toolkit for creating web services based on Oracle database objects;

- Increased security. The platform allows you to choose the method of application protection from the list of SSO, LDAP or authorization through social networks. APEX programs may include security tracking and auditing [6].

2.1.2 Oracle APEX Analogues

The market for the development of information systems and databases today offers many software products for the implementation of ERP systems of various levels of complexity. Competitors of Oracle Application Express include Apache OpenOffice Base, Appian, Appery.io, etc.

Apache OpenOffice Base is a full-featured database management system designed to meet the needs of a wide range of users, from tracking personal CD collections to creating corporate monthly department sales reports. The base has built-in functionality to help users create tables, queries, forms, and reports, as well as a set of predefined table values to track assets, customers, sales orders, invoices, and more.

Base offers a complete HSQL relational database engine configured for a single user, with data stored directly in the Base file, as well as built-in support for dBase flat files.

For advanced users in the enterprise, Base provides native driver support for a variety of multi-user database engines: MySQL, Adabas D, MS Access, and PostgreSQL. In addition, support for standard JDBC and ODBC drivers allows connection to almost any database [7].

Advantages of Apache OpenOffice Base:

- Cross-platform compatibility (Windows, Linux, Mac OS X);

- Available extensions and templates;

- Available commercial support;

- Improvement of extensions;

- Unified menu API;

- Productivity increase;

- The binfilter module has been removed (outdated StarOffice file formats (.sdw, .sdc, .sdd, etc.);

- Updated Python support;

- Support for the C++ STL system [8].

Appian is an industry-leading low-code platform that helps companies manage their processes, business and customers more efficiently. We've had workflow and case management software for decades, but until new "low-code" tools like Appian and Pega came along, you had to buy that software from a vendor with whatever functionality and look and feel it had.

Appian Features:

- Case management;

- Work process management;

- Chat-bots and virtual assistants;

- Integration with UiPath.

Low code is a relatively new term in the app industry. In general, this refers to programs that use a simple interface to develop code - instead of writing the code yourself. Learning how to use the software becomes easier thanks to the visual interface. You have to learn how to use the software, but learning Appian is much easier than learning .NET or Java.

Not having to write custom code to configure Appian also has other benefits – it's much easier to troubleshoot when things don't work right.

With low-code applications, you can focus more on designing the process and getting the right results faster and easier. Appian is also easy to integrate with other systems. Instead of expensive and time-consuming complex system integration, Appian allows you to connect to systems using APIs (it comes with a bunch of its own APIs, built-in or available on its market) [9].

Appery.io is a cloud-based HTML5, Ionic, jQuery Mobile and hybrid platform for mobile, web and PWA development. Appery.io is a browser-based drag-and-drop visual designer tool supporting Android and iOS with integrated Apache Cordova/PhoneGap derivation. The platform is used by DIYers to create apps for their customers.

The platform includes an application builder, server services, API Express, and plugins. App Builder enables cross-platform development using a common API that works on iOS and Android. The UX is built using Ionic, jQuery Mobile and HTML5 components with a drag-and-drop feature. Appery.io's internal services provide hosting, a MongoDB NoSQL database, push notifications, JavaScript server code, and a secure proxy. API Express helps synchronize Appery.io applications with internal systems. Plugins connect the application to ready-made REST API services, pages and data binding [10].

Advantages of Appery.io:

– Cross-platform functionality;

– Drag and drop user interface designer;

– A collection of pre-configured modules and ready-to-use plugins;

– Automatic generation of REST API;

– Built-in collaboration tools;

– Reliable security [11].

2.2 Justification of the choice of technologies for the development of the client part of the program

Page interfaces and the entire front-end part of PlazmIS IS is developed using the JavaScript programming language. In addition, the jQuery library is used.

2.2.1 JavaScript

JavaScript is a text-based programming language used on both the client-side and server-side to make web pages interactive. While HTML and CSS are the languages that give structure and style to web pages, JavaScript gives web pages interactive elements that engage the user. Common examples of JavaScript you might use every day include a search box on Amazon, a news summary video embedded in The New York Times, or an update to your Twitter feed.

The inclusion of JavaScript improves the interaction with a web page, transforming it from a static page to an interactive one. In summary, JavaScript adds behavior to web pages. JavaScript is mainly used for web applications and web browsers. It is also used outside the Internet in software, servers, and embedded hardware controls [12].

JavaScript was originally known as LiveScript, but Netscape changed its name to JavaScript, possibly because of the excitement caused by Java. JavaScript first appeared in Netscape 2.0 in 1995 under the name LiveScript. The general-purpose language core was built into Netscape, Internet Explorer, and other web browsers. The ECMA-262 specification defined the standard version of the JavaScript core language.

Advantages of JavaScript:
− Less interaction with the server - there is an opportunity to check the data entered by the user before sending the page to the server. This saves server traffic, which means less load on your server;

- Instant feedback to visitors - it doesn't have to wait for a page reload to see if they forgot to enter something;

- Increased interactivity – You can create interfaces that respond when the user moves the mouse over them or activates them with the keyboard;

- Increased interactivity – there is an opportunity to create interfaces that respond when the user moves the mouse over them or activates them with the keyboard;

- Advanced interfaces – there is an opportunity to use JavaScript to include elements such as drag-and-drop components and sliders to provide your site visitors with an advanced interface [13].

In 2017, IBM called JavaScript one of the most promising programming languages today. It is used both on the client side and on the server side, helping to create simple and convenient interfaces, the functionality in JavaScript is the richest. The scope of JavaScript is not strictly limited - JS is used in applications for PCs, mobile devices and servers.

It is important to understand the difference between JavaScript frameworks and JavaScript libraries. Frameworks are a frame, a template that imposes restrictions on the architecture of the program being created. The developer expands this basis, but only according to the previously known rules for working with Javascript frameworks. The library has no such restrictions. The most popular Javascript frameworks include: Angular JS, Aurelia JS, Backbone.js, dhtmlx Suite, Ember.js, jQuery, KnockoutJS, Meteor.js, Node.js, Polymer.js, React.js, etc. [14].

jQuery is an open-source JavaScript library that simplifies the interaction between an HTML/CSS document, or rather the Document Object Model (DOM), and JavaScript. By clarifying terms, it simplifies HTML document traversal and manipulation, browser event handling, DOM animation, Ajax interaction, and cross-browser JavaScript development.

Some of the key points that make jQuery popular are:

– Helps manipulate HTML and CSS;

– Helps manipulate DOM (Document Object Model) elements;

– Provides event methods to initiate and respond to events on the html page, such as mouse clicks, key presses, etc;

– Implements AJAX calls;

– Using jQuery (a JavaScript library) in an HTML page: There are several ways to start using it on your website.

Advantages:

A wide selection of plugins that allow developers to create plugins based on the JavaScript library;

Large community of developers;

– It is much easier to use compared to standard JavaScript and other JavaScript libraries;

– It allows users to easily develop Ajax templates. Ajax provides a more attractive interface that allows actions to be performed on pages without requiring the entire page to be reloaded;

– Light weight and powerful capabilities of the chain make it stronger [15].

2.2.2 JavaScript analogues

Analogues of JavaScript include: Java, PHP, Python, etc.

Java is a widely used programming language for writing Internet applications. The Java language has been widely used for more than two decades. Millions of Java programs are still in use today. Java is a cross-platform, object-oriented, and web-centric language that can be used as a platform in itself. It is a fast, secure and reliable programming language for everything from mobile applications and enterprise software to big data applications and server technologies. The popularity of Java lies in its ease of use. Advantages of the Java language:

– Because Java has been around for a long time, there are many learning resources for new programmers. Detailed documentation, comprehensive printed materials, and tutorials guide developers throughout their training. In addition, beginners can start writing Core Java code before moving on to Advanced Java;

– When using Java, developers do not need to write a new function from scratch every time. As an alternative, Java provides a rich ecosystem of built-in functions and libraries for developing a range of applications;

– Java has many active users and a community that can support developers when they encounter difficulties in writing code. Java software is also regularly supported and updated;

– The Java language offers various tools to support automated editing, debugging, testing, deployment, and change management. These tools make Java programming economical and fast;

– Java code can run on any underlying platform such as Windows, Linux, iOS or Android without rewriting. Thus, the language is particularly effective in today's environment where applications run on multiple devices;

– Users can download untrusted Java code over the network and run it in a secure environment where it cannot do any harm. Untrusted code cannot infect the host system with a virus, nor can it read or write files from the hard disk. Security levels and restrictions in Java are also easily configurable [16].

PHP is a popular programming language, especially among web developers. The author of the initial version is Rasmus Lerdorf, whose idea was to develop a set of tools to simplify the process of creating dynamic web pages. Although modern PHP is a general-purpose language, it is most often used as a server-side tool to generate HTML code that is then interpreted by a web browser. It is an open-source

programming language developed by enthusiastic programmers from all over the world. It has a simple syntax, partially similar to Java and C++. This is a constantly developing project, currently the 7th version of the language is relevant. According to statistics, every sixth software product is created on PHP.

The popularity of PHP is due to the following advantages:

– Simple and intuitive syntax. PHP is quickly mastered even by novice programmers. It incorporates all the best features of such popular languages as C, Java and Perl. PHP code is easy to read regardless of the way of use (for writing small scripts or creating powerful applications using an object-oriented approach to program implementation);

– Cross-platform and flexibility. PHP is compatible with all popular platforms (Linux, Windows, MacOS). The programs written on it work successfully on various server software (IIS, Nginx, Apache and many others);

– Excellent scalability. PHP allows you to achieve the maximum performance of applications written in it with the growth of hardware resources. Web applications distributed over several servers allow coping with significant loads (high traffic);

– Expendability in HTML documents. You can easily add dynamic content to a simple HTML page by inserting blocks of PHP code. They are added in the same way as HTML tags, they do not break the structure of the document;

– Active development and improvement. The development community is constantly working on the introduction of additional functionality that extends the capabilities of the language, simplifying the syntax and improving protection against possible attacks;

– Detailed documentation. The official website of the project presents complete information about each functional unit of the language, with examples of use;

– Simple search for solutions to emerging problems. There are many forums on the Internet dedicated to PHP programming.

– Broad prospects for its further development. Most CMS were built on pure PHP and frameworks. This is due to the popularity and demand of PHP programmers [17].

Python is a programming language widely used in Internet applications, software development, data science, and machine learning (ML). Developers use Python because it's efficient, easy to learn, and cross-platform. Python programs are free to download, compatible with all types of systems, and speed up development.

The Python language has the following advantages:

– Developers can easily read and understand Python programs because the language has a basic syntax similar to that of English;

– Python helps developers to be more productive because they can write programs in Python using fewer lines of code than in other languages;

– Python has a large standard library containing reusable code for almost any task. As a result, developers don't have to write code from scratch;

– Developers can easily combine Python with other popular programming languages: Java, C, and C++;

– Active Python community consists of millions of developers from all over the world. In case of problems, the community will help in solving them;

– In addition, there are many useful resources on the Internet for learning Python. For example, you can easily find videos, tutorials, documentation, and developer guides;

– Python can be ported to various operating systems: Windows, MacOS, Linux, and Unix [18].

2.3 Conclusions

Data management and decision-making are complex tasks that require considerable attention and responsibility. That's why today's businesses are quickly abandoning legacy solutions for resource planning, sales management, marketing, HR and finance. More than half of enterprises consider ERP as one of the priority sectors for investment. The ERP software market is growing at a rate of 10% annually, and its total share is expected to reach $90 billion by 2028 [5].

"PlasmIS" is a large multi-level ERP system, which was developed on the basis of the requirements of the plants of the group of companies "PlasmaTec" PrJSC. This is the largest corporation for the production of raw materials and a full cycle of welding electrodes in Ukraine. In 2011, the "PlasmIS" ERP system was created. Since that time, the system is in the stage of use and constant updating and improvement based on the constant development of production at the factories of PrJSC "PlasmaTec". The operation of this system covers all stages from initial production to transportation of finished products, taking into account production processes at each of the corporation's plants [1, 20].

The production of electrodes is impossible without the supply and production of special raw materials. When the raw material arrives at the factory or plant, it must be quickly entered into the system with one-time printing of a special tag to mark the container in which the raw material is located. For this, the task was set in the development of the "Tags about batch and containers" module, which will facilitate and automate the process of receiving raw materials at the plant.

The "Tags about batch and containers" module is an automated intelligent unit of the information system related to warehouse accounting. The main requirements that were set for the section are the collection, analysis and storage of individual data, followed by combining them into a comprehensive table for convenient use. In addition to the analysis of these data, special attention was paid to the printing of tags. All collected information is collected using certain technologies in tags that can be conveniently and quickly printed using the interface and special functions.

3 MODELS DEVELOPMENT OF AUTOMATED TAG PRINTING

3.1 Information model of automated tag printing

The formal relations [19] that allow us to consider the informational component of the "Tags about batch and containers" [20] module in terms of the relational data model is:

$$RE = \{item, item\_part, barcode, item\_storage, item\_unit\_storage\}, \quad (3.1)$$

where, *Item* - relation for the description of material values; the attributes that make up this relation are: *itm_id*(ID code of a certain material value), *itm_unt* (the basic unit of measurement in which this material value is measured), *itm_mrk*(the mark of the material value), *itm_name*(the name of the material value in Ukrainian), *itm_name_rus* (the name of the asset in Russian), *itm_name_en* (the asset in English), *itm_comment* (notes), *itm_rec_dt* (the date of the last changes to the information on the individual asset), *itm_rec_st* (current status) etc.

$$Item \subset itm\_id \times itm\_itmg \times itm\_unt \times itm\_mrk \times itm\_code \times itm\_inv \times itm \quad (3.2)$$
$$\_inv\_b \times itm\_name\_rus \times itm\_name\_eng \times itm\_name\_b \times itm\_comment$$
$$\times itm\_rec\_dt \times itm\_rec\_st \times itm\_obi\_ts,$$

Item_part- relation for characterizing lots; the attributes that make up this relation are: *itpt_id*(ID code of a batch of a certain material value), *itpt_dpr*(ID code of a material value),*itpt_num*(batch number), *itpt_dt*(date of batch creation), *itpt_st* (current status), *itpt_comment* (comments), *tpt_crtf* (certificate), etc.

$$Item\_part \subset itpt\_id \times itpt\_dpr \times itpt\_itm \times itpt\_itm\_equip \times itpt\_ca \times itpt\_$$
$$crtf \times itpt\_mrk \times itpt\_kind \times itpt\_num \times itpt\_num\_org \times itpt\_dt \times itpt\_st \times \quad (3.3)$$
$$itpt\_comment \times itpt\_obi\_ts ,$$

Barcode - a relationship for characterizing basic data about the batch, container. A tag is formed from this table. The attributes that make up this relation are: *bc_id*(ID code of a certain lot, container), *bc_itpt*(id code of a lot of material value), *bc_grp*(group by lot, container), *bc_count*(quantity/weight), *bc_comment*(comments), *bc_rec_st* (current status), *bc_rec_dt* (датазапису), *bc_dt* (date), *bc_seal* (seal) etc.

$$Barcode \subset bc\_id \times bc\_itpt \times bc\_ist \times bc\_grp \times bc\_count \times bc\_comment \times$$
$$bc\_rec\_st \times bc\_rec\_dt \times bc\_obi\_ts \times bc\_ius \times bc\_dt \times bc\_seal \times$$
$$bc\_st ,$$

(3.4)

Item_unit_storage- relation for the characteristics of storage units; the attributes that make up this relationship are: *ius_id*(ID code of a specific storage unit), *ius_name*(name of a specific storage unit), *ius_koef*(coefficient of the storage unit), *ius_rec_st* (current status), *ius_rec_dt* (recording date), *ius_comment* (notes), *ius_name_rus*(name of a specific storage unit in Russian), *ius_name_en*(name of a specific storage unit in English) etc.

$$Item\_unit\_storage \subset ius\_id \times ius\_itm \times ius\_unt \times ius\_unt\_rpt$$
$$\times ius\_mrktr \times ius\_pck \times ius\_name \times ius\_name\_rus \times ius\_nam$$
$$e\_eng \times ius\_coef \times ius\_is\_use\_price \times ius\_unt \times ius\_descript$$
$$\times ius\_comment \times ius\_rec\_st \times ius\_rec\_dt \times ius\_obi\_ts,$$

(3.5)

Item_storage- relation for the characteristics of storage places; the attributes that make up this relation are: *ist_id*(ID code of a specific storage location), *ist_tp*(storage location type), *ist_num*(storage location number), *ist_name*(storage location name), *ist_comment*(comments), *ist_rec_st*(current status), *ist_rec_dt*(record date) тощо.

$$Item\_storage \subset ist\_id \times ist\_ist \times ist\_dpr \times ist\_itm \times ist\_plt \times ist\_tp \times ist \\ \_num \times ist\_name \times ist\_weight \times ist\_comment \times ist\_rec\_st \times ist\_rec\_d \\ t \times ist\_obi\_ts \times ist\_pck,$$
(3.6)

In figure 3.1, the considered relations of the label printing model are presented in the form of a database scheme.
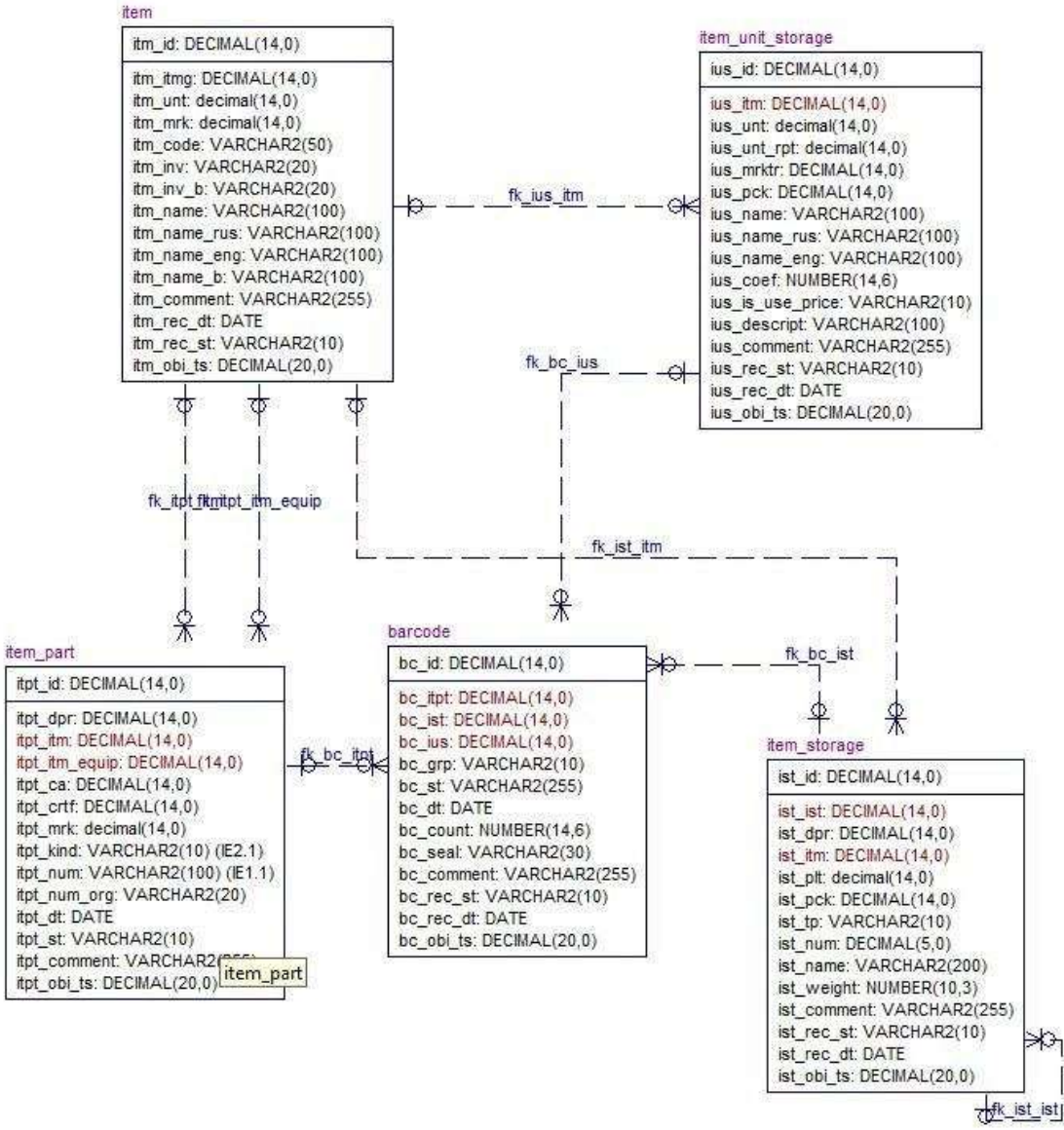

Figure 3.1 – Representation of label printing model relations in the form of a database schema

All tables are linked. The main *barcode* table has links with other tables: with the *item_part* table there is a (one-to-many) link based on the *bc_itpt* field - from the lot of the storage location, with the *item_storage* table there is a (one-to-many) link based on the *bc_ist* field - item storage id, with the *item_unit_storage* table there is a (one-to-many) relationship by field *bc_ius* - storage unit id.

The *item* table has relationships with the following tables: with the *item_part* table, a (one-to-many) relationship on the *itpt_itm_equip* field - equipment and a (one-to-many) relationship on the *itpt_itm* field - *item id* (equipment), with with the *item_storage*table there is a (one-to-many) connection by the *ist_itm* field - the *item id* (storage location), with the *item_unit_storage*table there is a (one-to-many) connection by the *ius_itm* field - the item id (storage unit).

3.2 Functional model of the intelligent module

3.2.1 The model of the knowledge base of the "Batch-container tags" module

A tag is a table that is compiled through HTML code and defined through field names. In general, field names change depending on the company. Using the ID of the tape from the barcode table, values are substituted into special variables, which later form the tag. For this, a knowledge base of the production type [21] of the intelligent module "Tags about batch and containers" was developed, which consists of a set of production rules, predicates, functions and operators. In particular:

1) Tags are being printed (function *PrintL*) the possibility of replacing the factory logo in the upper part of the tag is taken into account. For each enterprise, it is necessary to ensure that the logo of this enterprise is obtained from a separate database. So, if the logo l$_i$деякогоi-гоenterprise with$N$absent in the system, a universal logo is selected for printingl_{univ}("PlasmaTec companies group"), otherwise a personal logo is selectedl_i. Products are defined as follows*LogoR:*

$$\text{If} A \ (l_i) \text{then} Print \ (l_i) \text{else} PrintL \ (l_{univ}), \qquad (3.7)$$

where the predicate A (l_i) is defined as follows:

$$\exists l_i \mid i \in \{1,2,\ldots N\} \rightarrow A(l_i) = True \qquad (3.8)$$

2) The system database has a variable named Form. In this variable in case of activating the print function *PrintF* for *j* division of the enterprise with *M* (e.g. drawing area, packing area, warehouse, etc.) the form number is inserted. If there is no form number in the print parameters, then employees have the opportunity to write it down, but in the case of printing without a form number, the value of the variable *F* as the field on the tag is not inserted. Products are defined as follows *FormaR*:

$$If B \; (f_j) then Print \; (f_j) else PrintF \; (Null), \qquad (3.9)$$

where the predicate B (f_j) is defined as follows:

$$\exists f_j \mid j \in \{1,2,\ldots M\} \rightarrow A(f_i) = True \qquad (3.10)$$

3) System users can independently edit the fields in the tag that they need. In order to maintain flexibility, drop-down lists have been developed in the print window: "Do not print" and "Do not insert". Through the "Do not print" menu, users can choose *j* lines r_j from *LR* table tag, which do not need to be printed through the function *PrintRow*, and through the "Do not insert" menu, there is an opportunity not to insert values into certain ones *j* lines with *LF* table tags by function *PrintField*. Products are defined as follows *RowR* (3.11) and *FieldR* (3.13):

$$If Row_j then PrintRow \; (r_j) else PrintRow \; (Null), \quad (3.11)$$

where the predicate Row_j is defined as follows:

$$\exists\ Row_j \mid j \in \{1,2,\dots LR\}\ \rightarrow\ Row_j = True \qquad (3.12)$$

$$\text{If} Field_j \text{then} PrintField\ (r_j) \text{else} PrintField\ (Null), \qquad (3.13)$$

where the predicate $Field_j$ is defined as follows:

$$\exists\ Field_j \mid j \in \{1,2,\dots LF\}\ \rightarrow\ Field_j = True \qquad (3.14)$$

4) For universal printing of the tag on different printers, a method of turning the tag itself on was developed 90°. For this, a separate drop-down list with options was created 0° and 90°; in js-file the method of turning the tag on is laid down 90°. If the option is selected by the user 90° (predicate *Turn* defined as *True*), the production rule *TurnR* tag rotation via function *PrintTurn* looks like:

$$\text{If} Turn \text{then} PrintTurn\ (Go) \text{else} PrintTurn\ (Null), \qquad (3.15)$$

wherevariableis

$$Go = \text{``}.css('transform', \text{`}rotate(\${this.value()}deg)\text{`});\text{''} \qquad (3.16)$$

5) To center the tag on the paper (move it to the right or left), the Indentation field is provided in the database (*indent*). This repositions the tag horizontally by specifying the number of pixels in dots (*pixel_count*), to which you want to move the tag. Shift operator:

$$O_{pc} : (indent) \rightarrow pixel\_count \qquad (3.17)$$

6) One of the most important elements of a tag is a barcode. It is developed through a special function that generates a visual representation of the barcode *BarcodeImage*. The barcode itself is formed from three fields: *id* part material value (*id_part*), id storage of things (*id_goods*) and id barcode (*id_barcode*). Barcode printing operator:

$$O_b: (id\_part, id\_goods, id\_barcode) \rightarrow BarcodeImage \qquad (3.18)$$

So, as a result of the study, a model of the knowledge base [22, 23] of the intellectual module " Tags about batch and containers " was developed:

$$KnowledgeBase = \; < Rule, Pr, Func, Op >, \qquad (3.19)$$

consisting of production rules:

$$Rule = \{LogoR, FormaR, RowR, FieldR, TurnR\}, \qquad (3.20)$$

predicates:

$$Pr = \{A(l_i), B(f_j), Row_j, Field_j, Turn\}, \qquad (3.21)$$

functions:

$$Func = \{PrintL, PrintRow, PrintField, PrintTurn\}, \qquad (3.22)$$

And operators

$$Op = \{O_{pc}, O_b\}, \quad (3.23)$$

3.2.2 Printing tags on a page

In the process of printing tags on paper media (pages of any format), there are a number of certain features that must be taken into account, in particular:

- limited number of tags that can fit on a page;
- printing parameters;

- each tag must be continuous (tag breaks between pages are not allowed);

- printing is carried out in book orientation of the page.

For example: a standard A4 page has dimensions of 210 mm / 297 mm. The standard admissible size of the label printed from the interface is 10 mm / 10 mm. Then, a dependency is used to calculate the number of tags K that fit on a sheet of a certain format:

$$К = \left[\frac{y_л}{y_б}\right] \cdot \left[\frac{x_л}{x_б}\right] \qquad (3.24)$$

where, $y_л$ and $y_б$ – sheet width and label width, respectively, $x_л$ and $x_б$ – sheet length and tag length. A whole part of the calculation will be the number of tags that will fit on a certain sheet.

3.2.3 Calculation of container weight

After the delivery of raw materials in a container to the factory, the technology requires the creation of a corresponding component. For this purpose, it is necessary to mix the raw materials in a certain proportion. Usually, the number of raw materials in a big-bag or other container is measured in tons, while the necessary additives to the raw materials can be measured in kilograms. To correctly calculate the amount of the same type of raw material in a container, you need to find the sum of the corresponding coefficient and the weight of i-thcontainerfrom$n$. For the correct calculation of the total $S_T$balance of certain raw materials in the container, we will apply the dependence:

$$S_Т = \sum_{i=1}^{n} k_i x_i, \qquad (3.25)$$

where k_i – coefficient, a x_i– weight of$i$-thcontainer from$n$.

The value of the weight of each i-thcontainer is saved in "Barcode"table, which is filled from the data of the receipt immediately after the raw materials have arrived at the factory.

3.4 Conclusions

A knowledge base is an online library (add-on) based on a database that stores information about a product, service, specific topics, or the company as a whole. Submitted data can be organized into topics and subtopics, and then easily shared with clients or colleagues. The simpler and more clearly organized the information in the knowledge base is, the more value it will bring to users [24].

As a result of the study of the technological features of the warehouse activity, a relational model of the intelligent module was developed, the proposed five relations of the label printing model are presented in the form of a database scheme. For creating a knowledge base, the composition of sets for production rules, predicates, functions, and operators, which were proposed as an add-on to database relations, was substantiated.

Examples of calculations of the number of tags that can be contained on paper of different formats, as well as the application of the proposed formula for calculating the weight of the container, are considered.

4 DEVELOPMENT OF PRINTING MODULE SOFTWARE

4.1 Designing the structure of the module

The creation of an ERP system helps to solve any tasks of the enterprise, to standardize and speed up the document flow, and to allocate resources correctly. The project implementation of such a system is the best option for automating business management. It is suitable for both medium and large enterprises with a complex structure. A thorough business analysis is necessary for the project implementation of the IT system. At the same time, experts study the features of the enterprise, its structure, tasks, existing business processes. The effectiveness of the corresponding IT system being designed depends on the results of the analysis stage [25].

There are numerous tools that are used to implement an IS project from the analysis stage to the creation of software code. The so-called upper-case tools (upper CASE tools) and lower-case tools (lower CASE tools) are distinguished separately. Among the main problems of using upper-level CASE-tools, the problems of their adaptation to specific projects are highlighted, since they strictly regulate the development process and do not provide an opportunity to organize work at the level of individual elements of the project. An alternative to them can be the use of lower-level CASE tools, but their use causes other problems - difficulties in organizing interaction between teams working on different elements of the project.

The unified language of object-oriented modeling (Unified Modeling Language - UML) is a means of combining these approaches. The advantages of the UML include a variety of tools that both support the IS life cycle and allow you to configure and display the specifics of the activities of developers of various project elements.

4.1.1 Use case diagram

Figure 4.1 shows the developed diagram of options for using the "Tags about batch and containers" functional module. This part of the information system involves the work of two actors: an employee and an administrator. After authorization and opening the interface with the module, the employee has two main activities: working with the interface and printing. Working with the interface includes the following operations: filling out search queries in the filter, reviewing the details by container, editing data, exporting data to Excel and adding data. The printing activity includes two operations: label printing and A4 printing.

The administrator, as an actor, has access to all the same functions as an ordinary employee, but after authorization, the operation of deleting data in working with the interface has been added to the functionality of the administrator.
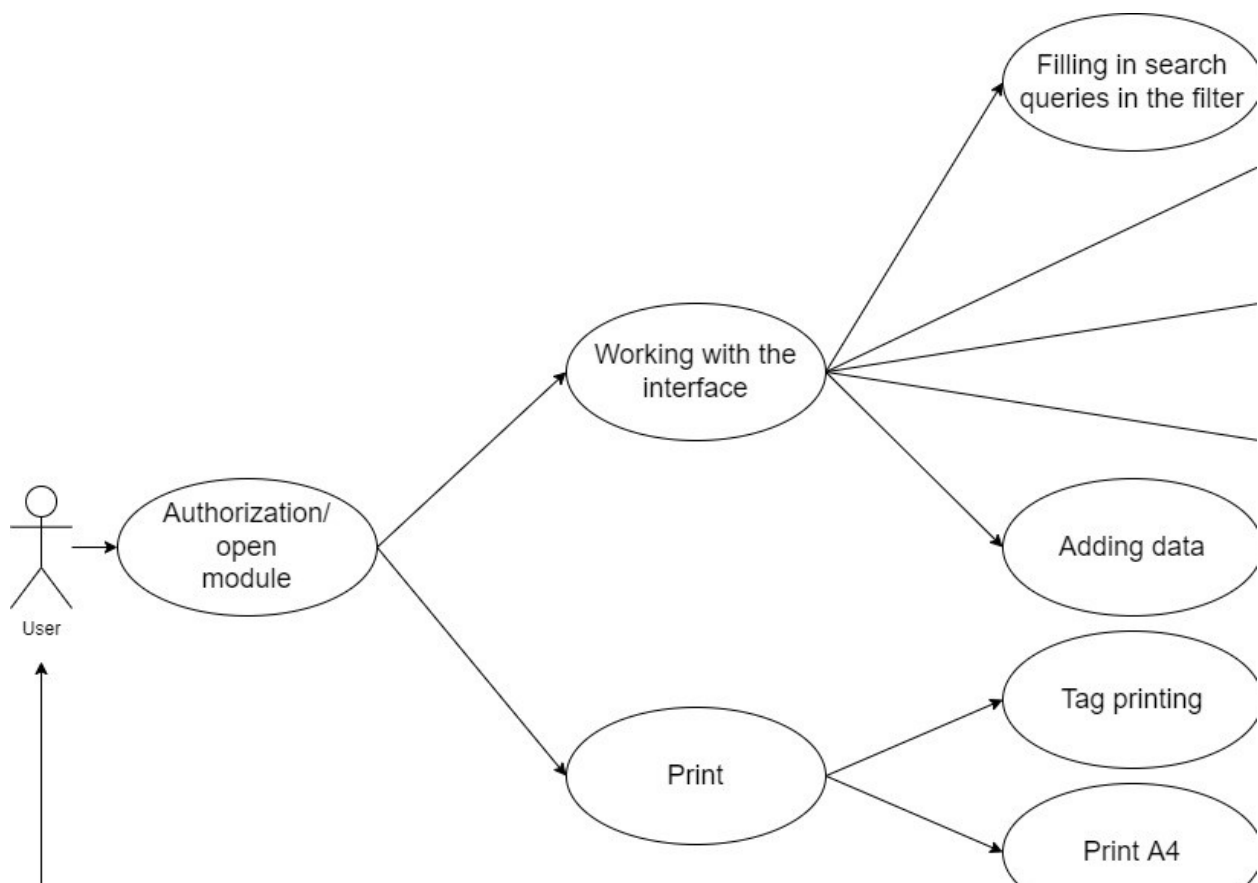

Figure 4.1 – Use case diagram for the use of the intelligent module "Tags about batch and containers"

4.1.2 Process sequence diagram

Ten objects connected by connections (edges) are selected on the process sequence diagram.

The user is a single object that embodies the activity of a living person. The first active action that starts the work of the section is "&APP_ID.:1390:&SESSION.::&DEBUG.:RP,1390:::" – that is, a command is given to access the data of 1390 page.

APEX Page – page with number 1390, this is the APEX PAGE of the "Batch-Tare Tags" module. This component combines all components and connections between back-end and front-end technologies. Using the link "GetFilterObject($("#filter_barcodes"))" the required filter (Filter object) – "filter_barcodes" – is loaded from the filter gallery onto the page. The filter processes the specified data and returns the sorted information. Using the command "barcodes.js / getBcGrid();" the selected grid and interface are loaded on the page. APEX Page also has a database connection (ninth object). When adding or updating data from the database, information is returned to be displayed on the interface.Main Interface – головнийінтерфейссторінкимодуля. З нього є доступ на вікнододавання, вікноредагування, вікнодруку, деталізація.

Command "newBcWindow.open({mode:'insert',grid:grid});" is opening add window. After entering the data in the fields, clicking the "Save" button executes the procedure "procedure Barcodes_WEB(that.mode == 'insert')" , which saves the data from the window to the database. New information becomes available when the APEX Page is opened, and the add window closes and the main interface is available again for further work.

Command "newBcWindow.open({mode:update,grid:grid});" is opening editing window. When the window is opened, it is transmitted *id*lines in *Barcode* table, this *id-code*the data required by the user for editing is opened. After editing the data, clicking the "Save" button executes the procedure "procedure Barcodes_WEB(that.mode == 'update')" which makes changes to the database. New

information becomes available when the APEX Page is opened, and the editing window closes. The main interface is available again for further work.

Command "newNewPrintSealWndw.open({mode:'insert',grid:grid});" is opening printing window. When the window is opened, it is transmitted *id*-codelines in *Barcode* table, this *id-code* the data required by the user for tag printing is opened. When the print button is pressed, the function is activated "this.getItmInfo4BcPrint()". The tag required by the corrector is printed, and the editing window closes. The main interface is available again for further work.

Separately, it is possible to open detailing - a set of tabs with additional related information. Detailing is opened by the command "detailInit: getBcClaimDetail" transmitting the *id* code of the tape, the information on which should be displayed. After processing the data in detail, it is closed.

Figure 4.2 shows a sequence diagram of the processes and functions of the "Tags about batch and containers" functional module.
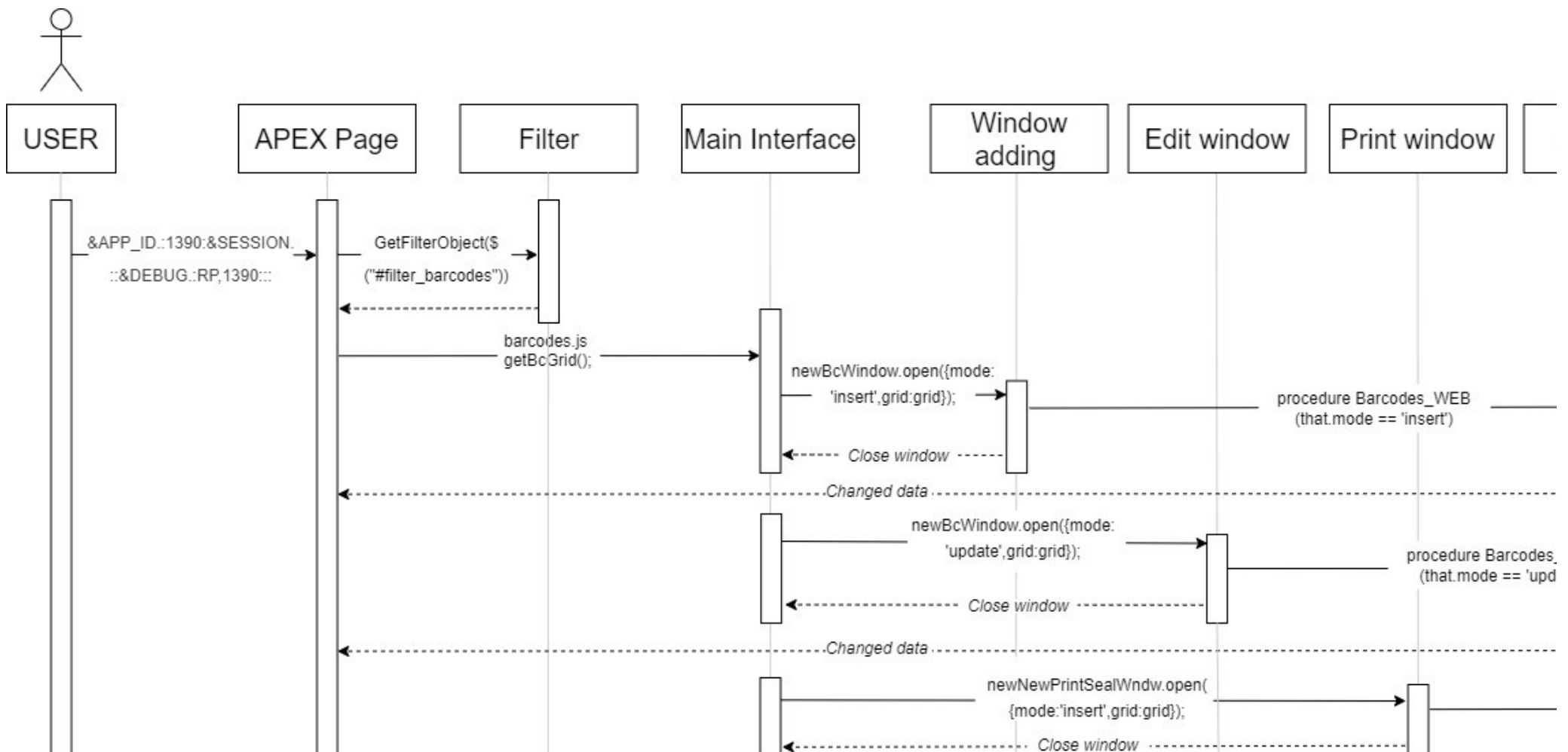
Figure 4.2 – Sequence diagram of the processes and functions of the "Tags about batch and containers" functional module.

4.2 Development of the user part of the application

The "Tags about batch and containers" module is developed as a separate web page of the warehouse accounting subsystem. The section consists of a search filter and a main grid. Figure 3.1 shows an image of the "Tags about batch and containers" module page.
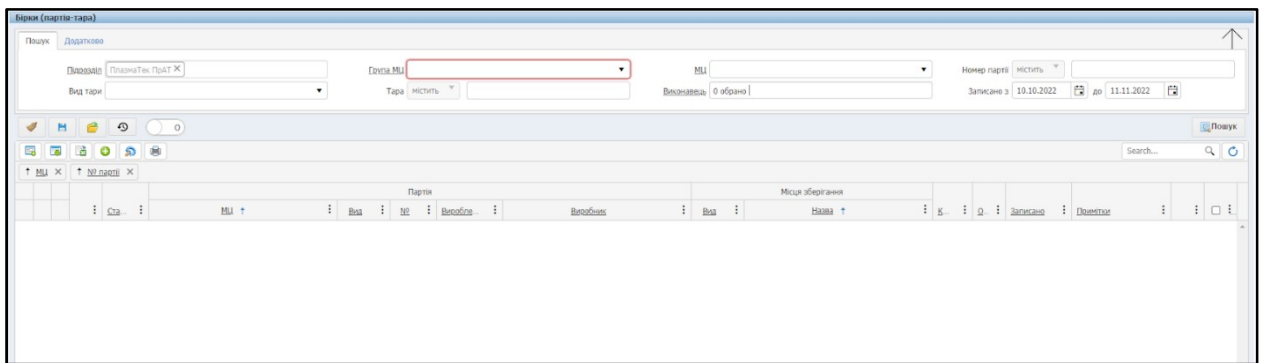

Figure 4.3 - Image of the page of the "Tags about batch and containers" module.

4.2.1 Searchfilter

A search filter or search system is a complex software and hardware complex designed to search for resources in a large collection of available data and provide the user with sorted information according to his search query.

In the "Tags about batch and containers" module, the filter consists of a main filter (8 search fields for entering information) and an additional one (2 search fields). Kendo UI was chosen to create the search filter. The advantages of Kendo UI are that it is a client-side framework and a set of more than 10 widgets (grid, graphs/charts, dropdown, etc.) that is powered by jQuery. This framework makes maximum use of technologies such as HTML5 and CSS3 (at the same time, it provides support for old browsers due to graceful degradation). Data binding, templates, animation, drag-and-drop and much more are supported [26]. The following Kendo elements were used in the development of the filter: kendoDropDownTree (drop-down list in the form of a tree), kendoMultiSelect (text field with search), kendoDatePicker (date), etc.

The main filter contains the first search field - "Subdivision". This element is responsible for selecting the company where the user works. It is blocked by default. Depending on the company at which the user is registered, information is displayed for the company.

Figure 4.4 shows the "Subdivision" search field.

Figure 4.4 – The "Subdivision" search field

The following search fields "Material Value Group" and "Material Value" are interconnected and sort information by existing material values. In the "Material Value group" field, a material value group is selected, and in the "Material Value" field, the material value corresponding to the selected Material Value group is selected.

For example, Figure 4.5 shows the "Material Value Group" field with the "rutile concentrate" group selected. After selecting the "Material Value group" in the "Material Value" field, it becomes possible to choose the desired brand of material value.
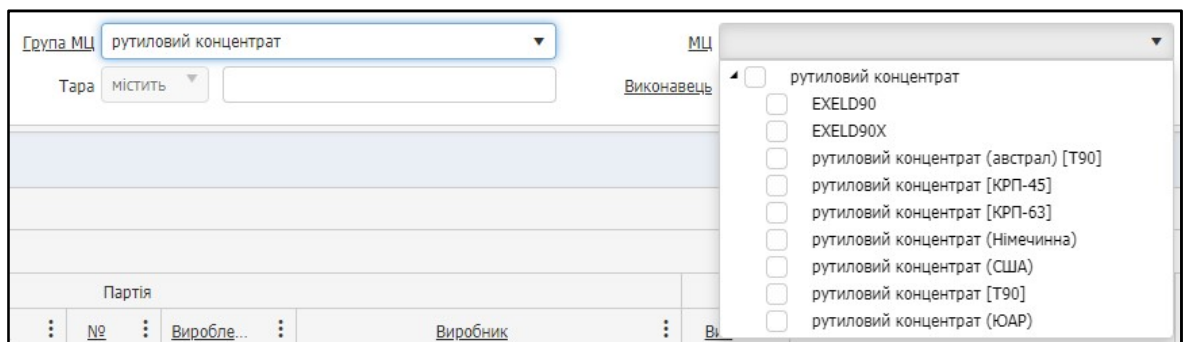
Figure 4.5 – "Material Value Group" and "Material Value" search fields

The next field is "Batch number". Filling in this field allows you to sort and display the data by the desired batch number. The "Tara" field works according to the same principle. Filling in this field allows you to select information on the container you need. Figure 4.6 shows the Batch Number search field, and Figure 4.7 shows the Container search field.

Figure 4.6 – Search field "Batch number"

Figure 4.7 – "Container" search field

The field "Tare type" was created for sorting and outputting information on the tare. Figure 4.8 shows the "Container Type" search field.
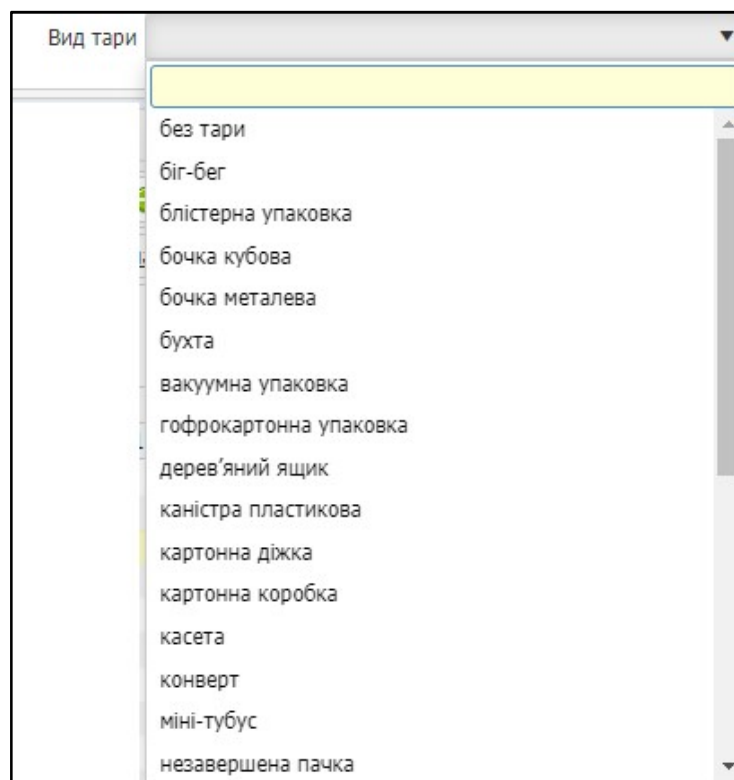
Figure 4.8 – Search field "Tare type"

Through the "Executive" field, we can select all the necessary workers who are registered for that batch-tare. Figure 4.9 shows an example of using the Artist search field.
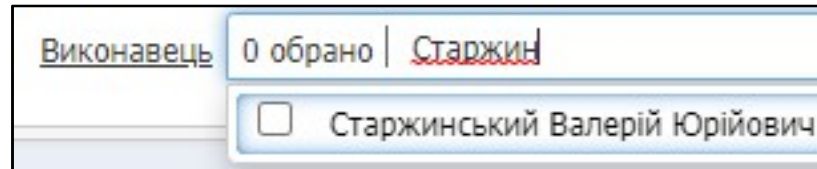
Figure 4.9 – Search field "Executive"
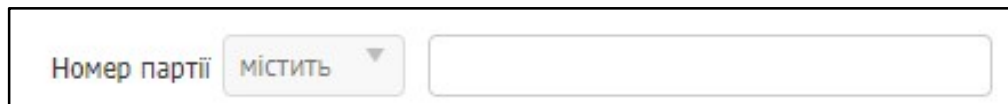
The last field on the main screen of the form is "Recorded from". Through this field, it is possible to sort the information by the recording date. By default, the sorting period is set to 30 calendar days, but users can change it. Figure 4.10 shows an example of using the Recorded From search field.

Figure 4.9 – Search field "Executive"

An additional filter can be found in the "Additional" tab. It has two fields: "Party from" and "Status". Through the "Batch from" field, it is possible to sort the information by the date of creation of the batch. Through the "Status" field, you can display current, deleted, seized documents. Figure 4.11 shows the "Batch from" and "Status" search fields.
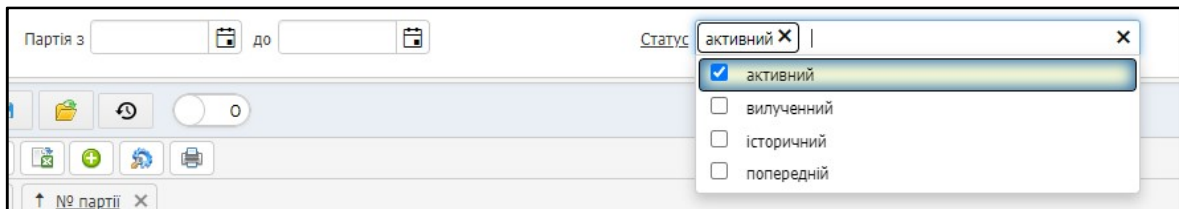
Figure 4.11 - "Batch from" and "Status" search fields

After filling out the search queries in the filter, pressing the "Search" button starts the process for all the filter fields and displays the relevant information in the main grid.

The search filter code is given in the Attachment B.

4.2.2 Main grid

Grid - presentation of data in the information system in the form of a table. The data is displayed in tapes, each tape is a separate batch-tare. This table has 19 columns in the "Batch-Tare Tags" section. Some columns are combined into sections (a set of columns according to certain parameters).

The first column is "Recording Status". This column corresponds to the status of the tape and is displayed with the corresponding picture. The status of the field can be active (active) or deleted (delete). Another related field is "Status". It describes in words what state a certain batch of containers is in.

The second section of columns is ID codes. ID contains unique identification numbers (ID) for each tape. This is from the place of storage, from the batch and from the batch-container.

The next section of columns contains information by batch. It includes the following main columns: material value (name of MC), No. (batch number), batch production date and manufacturer.

Next, a storage place section is provided, which includes two columns - "Type of container" (big-bag, barrel) and "Name of the storage place".

The next column is called "Quantity". The weight of each batch-tare is recorded here. After that, there is the "Storage Units" column, which describes in which units of measurement the weight of a certain batch-container is recorded.

The last information columns are the fields "Recorded" (recording date of a certain batch-tare) and "Notes" (you can enter additional information here).

Figure 4.12 shows an example of a grid with data on certain user requests.

Figure 4.12 – Grid

Separately, at the request of users, the possibility of grouping data by the "MC" and "Batch No." fields was added to the interface. This facilitates the process of information processing.

There is detail on each tape of the batch-tare - additional documentary related information. Details are opened by clicking on the special arrow.

Figure 4.13 shows an expanded detail for a specific batch-container.

Figure 4.13 – Detailing (Employees tab)

There are a total of seven tabs in the details. In the first tab, which is called "Employees", you can enter information on the performer. The second tab is

"Related tags". In this tab, a separate grid table is created, which displays data about related tags. A linked tag is a batch-container tag that, when transferred from one enterprise to another, goes through certain stages. The documentary data of this batch of containers is changing, but in order to learn certain points from the past enterprise, this detail tab has been created.

The next tab is "Documents by tags". This drill-down section runs a function that displays all documents associated with a particular tag. The following tab "Documents by party" works according to the same principle - all documents related to a certain party are displayed.

Figure 4.14 shows the Expanded Related Tags and Tag Documents tabs of the drilldown.
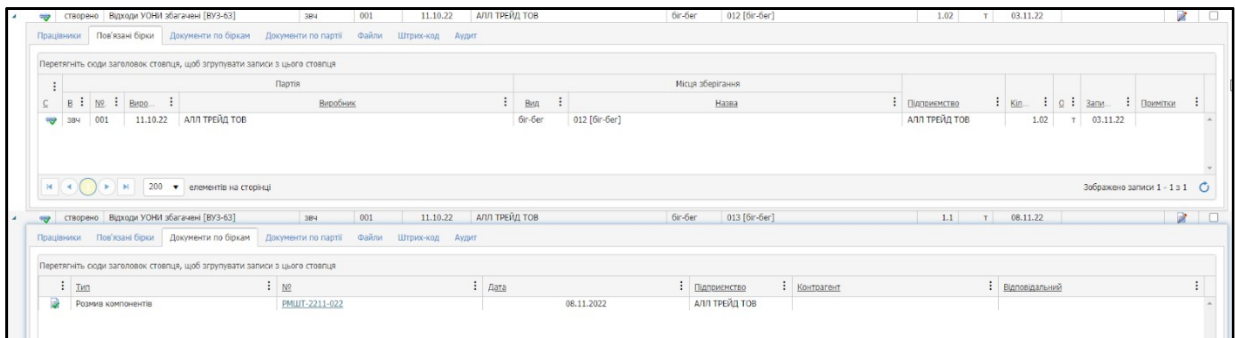
Figure 4.14 – "Related Tags" and "Documents by Tags" drilldown.

In the files tab, you can download certain additional files that users need.

The penultimate tab is "Barcode". In this detailing section, a special function is triggered that generates a unique barcode. The essence of the function lies in the fact that three ID codes are selected for a certain batch-container - ID of the batch of MC, ID of storage of things and ID of the barcode, and the barcode is already formed on their basis. The system notifies about the creation of a new barcode with a message (Figure 4.15). In Figure 4.16, a barcode is created for a specific batch-container.

Figure 4.15 - Barcode creation notification.
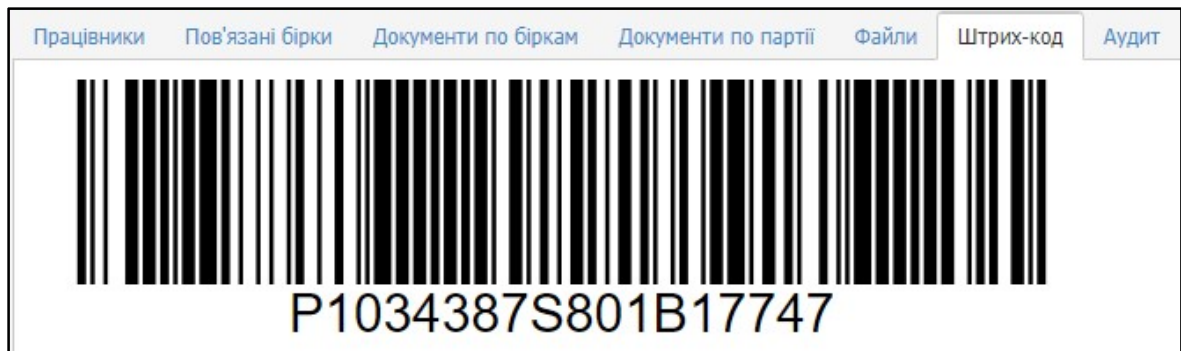
Figure 4.16 – Created barcode.

In the "Audit" tab, data changes on a certain batch-tare by users are recorded.

The function of generating barcode is given in the Attachment C.

4.2.3 Data processing in the subsystem

Operations can be performed in the "Batch-tare tags" section: adding data to the table, editing existing data, and printing tags. To perform the addition procedure, there is a special function that calls a window. You need to fill in several fields in the add window. The user has the opportunity to fill in the fields: group, material value, batch, type of container, container, quantity, storage units, production date, seal and notes. Some of these fields have the status of mandatory (marked with red stars), that is, the user must fill them. Otherwise, when saving data, if one of these fields is empty, the system will notify you of an error and will not allow new data to be saved.

The add window is called in several ways. One of these methods is to click on the "Add" button on the main interface and go to the window for filling in new data. Another way is to select a similar tab of the table to be filled in and then click on the "Add" button, in which case part of the fields (group, material value, type of container and date) will be inserted automatically.

Figure 4.17 shows the add window.

Figure 4.17 - Add window.

After filling in all the fields, the user can save the data by clicking the "Save" button and close the window, or save and continue adding information by clicking the "Save and Add" button.

To perform the editing procedure, a special function is provided that calls a window. Each batch-tare ribbon of the main grid has its own edit button, clicking on this button triggers the process of opening a window and inserting the selected data into the cells that were saved during the last update (adding or editing): group, material value, batch, type of tare, container, quantity, storage units, production date, seal and notes. The editing window is also used as an overview of the data in a convenient form. The functionality of the window has the ability to edit certain data. This is information about quantity (weight), seal and notes. All other data cannot be edited because they are used on other interfaces and modules. In the editing window, a drill-down is available, in which you can enter employees and process the information in the same way as in a normal drill-down. In addition to editing, you can also print the label from this window.

Figure 4.18 shows the editing window.
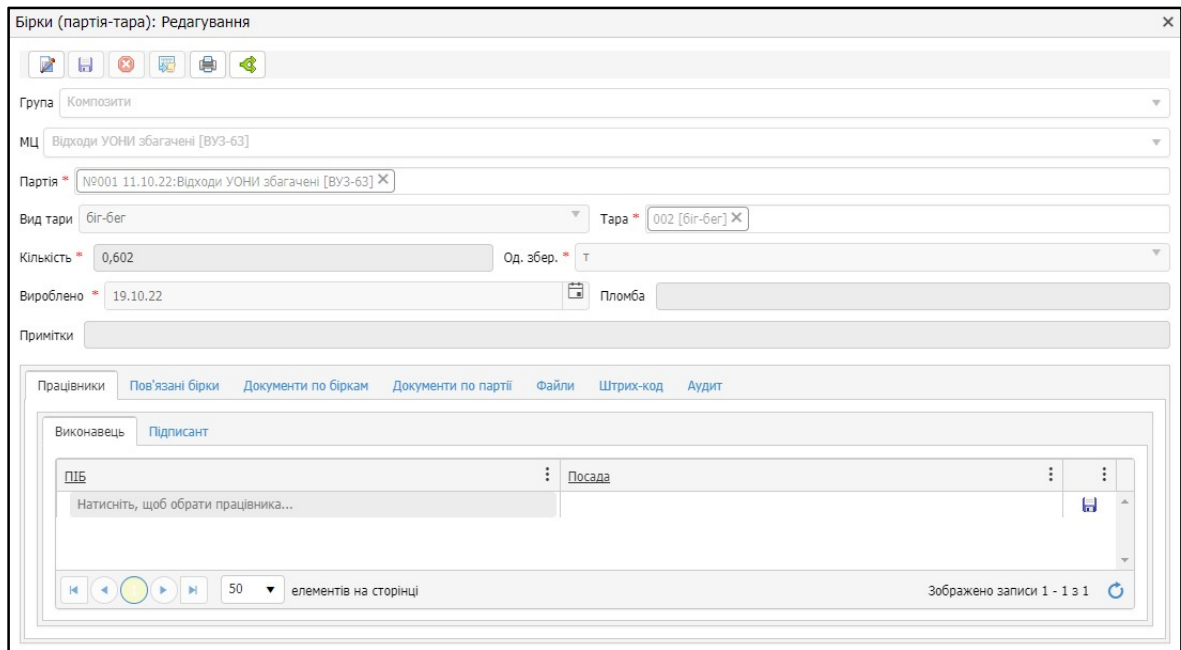
Figure 4.18 - Editing window.

4.2.4 Tag printing

Figure 4.19 shows a menu of buttons: loading and configuring layouts (page view for easy use), uploading grid data to Microsoft Excel, adding button, operations button, and printing.

To print one or an unlimited number of tags, you need to make a selection of them. This happens through check boxes (a special grid column with a choice). After the batches of containers for which you need to print labels have been selected, you need to click the print button, it is located at the top of the interface in the menu of buttons. After pressing the print button, a menu with two buttons appears: label printing (label) and label printing (A4). The main difference between printing a regular label and printing a label on A4 is that the height and width of the label and the borders of the sector in which it is located are different. Also, the printing of ordinary tags is adapted for a thermal printer. After pressing the print button, a print window with a label is displayed.

Figure 4.20 shows the print window. The window consists of setting fields and an image of the designed tag itself. The tag is compiled as an HTML table in a

js file. When transferring the ID code to special functions and procedures, all necessary information is entered into the tag.

Figure 4.20 - Print window.

In the print window, special fields were developed to unify the printing of labels:

- Height (height of indents around the tag);
- Width (width of indents around the tag);
- Do not insert (drop-down list of tag fields whose values do not need to be inserted);
- Do not print (drop-down list of tag fields whose ribbons should not be displayed and printed);
- Angle of rotation (possibility of rotating the tag by 90 degrees);
- Indents (indents to the left and right of the tag).

After the user has verified the correctness of the entered tag data, he presses the print button. After that, another function is triggered, which calls the standard printing procedures from the Windows OS, in particular the standard print window.

Figure 4.21 shows the Windows print window. When setting up the printer, the label is printed successfully.
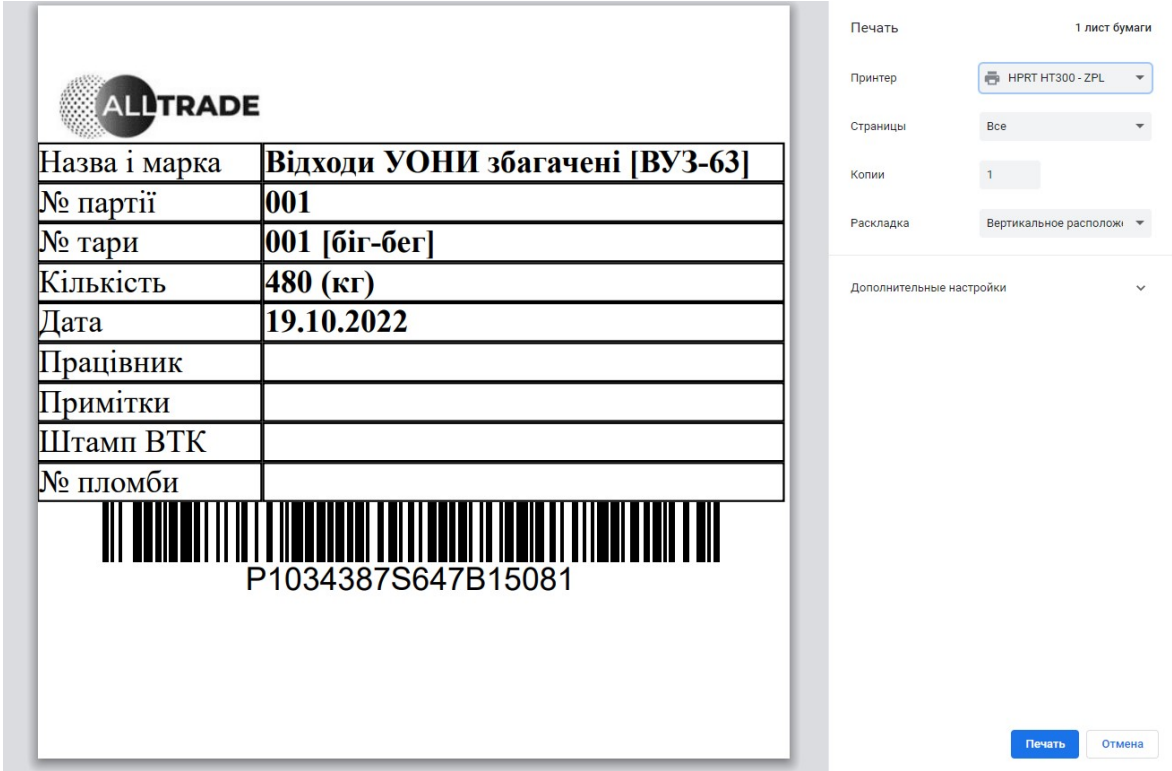
Figure 4.21 - Windows print window.

The tag generatingcode is given in the AttachmentD.

4.3 Implementation of the interaction of the client and server parts of the module

For the interaction between the server part and the user interface in the "PlasmIS" information system, Oracle Application Express (APEX) was chosen and applied.

Oracle Application Express (APEX) is a low-code development framework that enables you to build scalable, secure, feature-rich enterprise applications that can be distributed anywhere.

This framework allows applications built with APEX to access and interact with all Oracle Database features. Powerful JavaScript support allows you to create the desired user interface. APEX also has its own universal theme, which is used for various design elements and useful aids to support universal design requirements (WCAG 2.0). Built-in support for responsive design, which allows you to adapt web applications to the user's platform (mobile device, PC, tablet, etc.).

Because APEX scales with the database, it works equally well for building simple applications for internal data collection, webifying paper-based processes, bridging gaps between disparate systems, to large data-driven applications with thousands of users [27].

A regular web browser is used to run Oracle Application Express. There is no client software other than the user's browser that is required for development, deployment and execution. Application Express pages are displayed using HTML in the browser. Page requests and views are sent to Application Express in Oracle Database.

In the "PlasmIS" information system, there are two main applications in Application Express - the 120th application and the 130th application (the historical names from the developers are used). Appendix 120 is the main version of the system, which is designed specifically for a personal computer. Appendix 130 is a version with separate modules that need to be used with the Android operating system, in particular with TZD (data collection terminal).

In 120 and 130 applications, a separate page is created in the Page Designer for each IS page. This is a page editor. A large number of functions are available here, including: connection of JS/CSS files, creation of various processes (for drop-down lists, button click processes, etc.), additional connection of styles, filters, layouts. Figure 4.22 shows the appearance of the Page Designer section on the page of the Batch-Container Tags module.
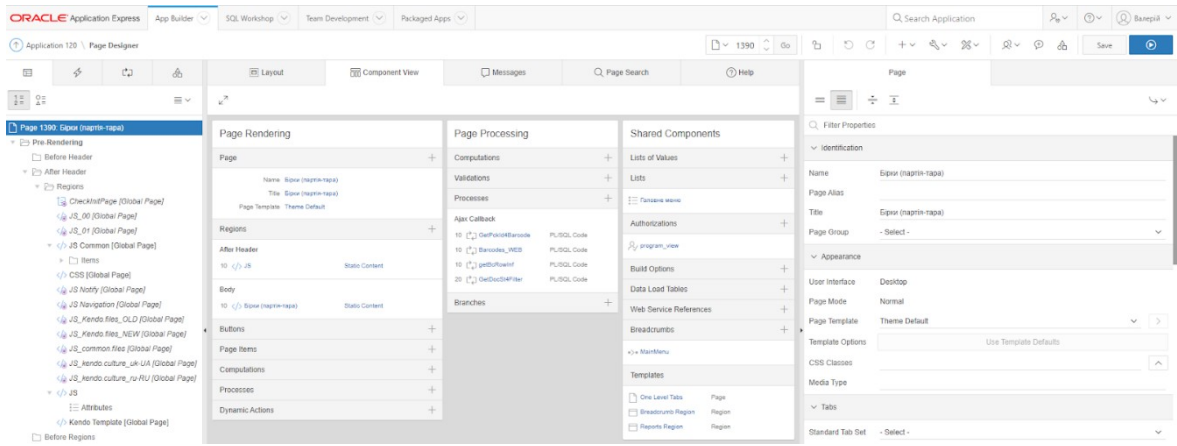
Figure 4.22 - Appearance of the Page Designer section

Figure 4.23 shows the architecture of the "PlasmIS" information system. The user works with an interface that is fixed through js/css files on the Application Express page. When creating new data or editing existing data, special functions and procedures overwrite information in the database.
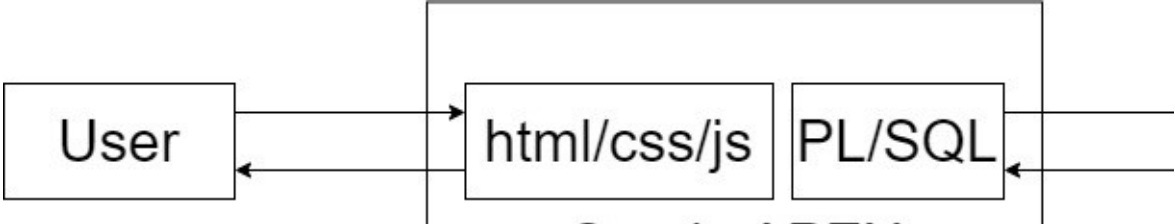
Figure 4.23 – Architecture of the "PlasmIS" information system operation

4.4 Features of the application of the 130th application

The "Batch-tare tags" module was also developed for the 130th application, taking into account the conditions for adapting the page to the Android OS. That is, the page is adapted to the screens of mobile devices (tablets, mobile phones, data collection terminals, etc.). Changes to the interface consist in the fact that in the 130th application, the filter fields were formed into one column (in the 120th application, it was 4 columns). But at the same time, the 130th application is also used on personal computers in various production areas of factories. Figure 4.24 shows the appearance of the Batch-Container Tags module page on the 130th

application. This image was created with the selection of screen extension through the console panel of the Google Chrome browser.
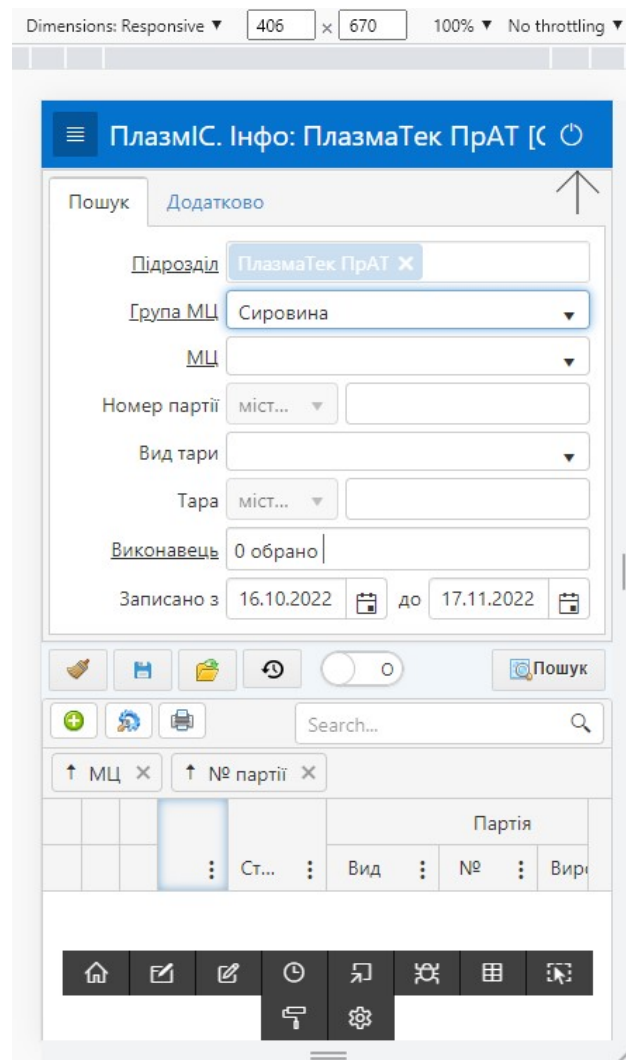
Figure 4.24 - Module "Batch-container tags" on the 130th application

The functionality of the module on the 130th application has not undergone significant changes. However, the layout of the columns was changed in the general grid. Figure 4.25 shows the external operation of the grid on the 130th application.
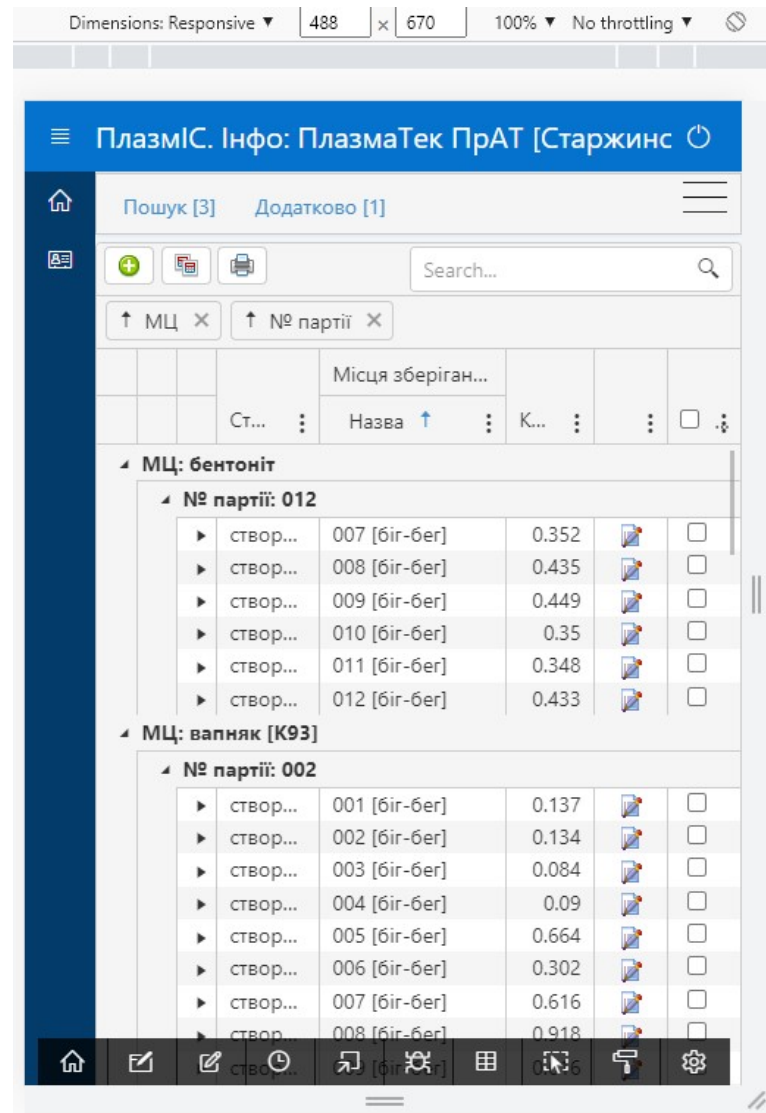
Figure 4.25 – External working out of the grid on the 130th application.

The add and edit window has also been adapted for Android devices. Figure 4.26 shows the editing window on the 130th application.
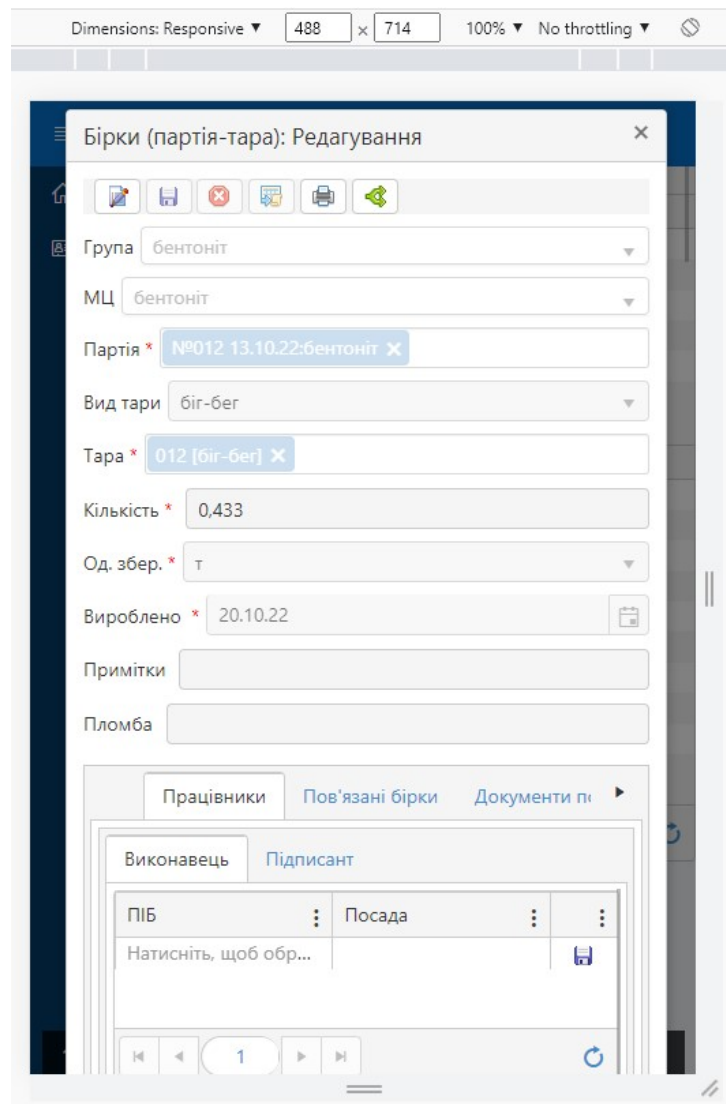
Figure 4.26 – Editing window on the 130th application.

4.5 Development testing

During the test checks, no defects and malfunctions were found in the operation of the module. Data was added to the tables for a new batch-container for a separate enterprise. The possibility of editing data in an already created batch-container has been checked. Checked details links, buttons and other functionality. The method of printing labels on A4 and 100x100 was also checked. Tags were successfully printed on various printers.

During the development of the application, the following was taken into account:

-   –   system speed;
-   –   simple and pleasant design;
-   –   logical schemes of entering and collecting information from the subsystem;
-   –   universality of the tag for different departments and enterprises;
-   –   ease of navigation through the interface, its compatibility with various browsers.

4.6 Conclusions

In this section, the main idea of creating an information module for printing tags was formalized. Using the scheme and construction of UML diagrams, the principles of operation of the intelligent module are shown.

As a result of the development of page layouts, a suitable front-end for pages is proposed, a description of changes when clicking on various objects is provided, application actions for communication with the database and the back-end part are provided and implemented.

The method of editing and adding data to the system was designed, the procedure for printing tags was designed and implemented.

5. ECONOMICAL SECTION

5.1 Technological audit of the developed intelligent module "Tags about batch and containers" for automated printing of tags in the "PlasmIS" information system

As mentioned earlier, the rapid development of information technologies of data storage, communications and processing allows storing and processing a large amount of information that is in cyberspace. In particular, the Enterprise Resource Planning software allows you to combine all the production and service departments of the enterprise with their specific functions into a single intelligent computer system in order to solve various problems and meet the various needs of these departments. That is, on the basis of a single ERP information system, different departments and services of the enterprise can easily exchange data and information with each other.

 In this regard, the creation of separate modules within the existing ERP system of the enterprise allows increasing the level of automation of certain types of work and, as a result, to achieve certain economic advantages of the enterprise as a whole.

Therefore, the goal of the master's qualification thesis was to develop software aimed at increasing the level of automation of label printing and recording of relevant data by developing the "Tags about batch and containers" module for the current information system "PlasmIS". To achieve this goal, we: analyzed the activity of existing ERP systems; an analysis of the work of individual departments of PJSC "PlasmaTek" (Rudnytsia) was made; a number of models of automated accounting of production data and architecture of the "Tags about batch and containers" module were developed; developed software and graphic support for the "Batch-Tare Tags" module, etc. In order to establish the commercial potential of the intellectual module "Party-container tags" developed by us for the automated printing of tags in the "PlasmIS" information system, 3

well-known experts - specialists in this field of knowledge were invited: candidates of technical sciences V.V. Harmash, Sofina O. Yu. and Professor Papinov V.M. The establishment of the commercial potential of the intellectual module "Tags about batch and containers" developed by us was carried out according to the criteria given in table 5.1.

Table 5.1 – Recommended criteria for evaluating the technical level and commercial potential of any development and their scoring

Evaluation criteria and points (on a 5-point scale)					
	0	1	2	3	4
Technical feasibility of the concept:					
1	The reliability of the concept is not confirmed	The concept is confirmed by expert opinions	Concept confirmedbyca lculations	The concept has been tested in practice	The product's performance in real conditions has been tested
Market advantages (disadvantages):					
2	Many analogues in a small market	Little analogues in a small market	Several analogues in a large market	One analogue on a large Market	The product has no analogues in a large market
3	The price of the product is much higher than the prices Analogues	The price of the product is slightly higher than the prices Analogues	The price of the product is approximately equal to the prices of analogues	The price of the product is slightly lower than the prices of analogues	The price of the product is significantly lower than the price Analogues
4	Technical and consumer properties of the product are much worse than those of analogues	The technical and consumer properties of the product are slightly worse than those of analogues	Technical and consumer properties of the product at the level of analogues	Technical and consumer properties of the product are slightly better than those of analogues	Technical and consumer properties of the product are much better than those of analogues
Market prospects					
5	Operating costs are significantly higher than those of analogues	Operating costs are somewhat higher than those of analogues	Operating costs at the level of operating costs of analogues	Operating costs are slightly lower than those of analogues	Operating costs are much lower than those of analogues
6	The market is small and has no positive dynamics	The market is small but has a positive trend	Average market with positive dynamics	Big stablemarket	Large market with positive dynamics
7	Active	Active	Moderate	Negligible	Therearenoc

	competition of large companies in the market	competition	competition	competition	ompetitors

ContinuationofTable 5.1

	Evaluation criteria and points (on a 5-point scale)				
	0	1	2	3	4
Practicalfeasibility					
8	There are no specialists in both technical and commercial implementation of the idea	It is necessary to hire specialists or spend significant funds and time on training existing specialists	A slight training of specialists and an increase in them is necessary State	Necessary Minor teaching Specialists	There are experts in both technical and technical issues. Commercial Implementation of the idea
9	We need significant financial resources that are missing. There are no sources of funding for the idea	Need insignificant financial resources. There are no sources of funding	Significant financial required Resources. Sources of funding are	Need Minor Financial Resources. Sources of funding are	Does not require additional funding
10	Needed development newmaterials	We need materials used in the military-industrial complex	Need Expensive Materials	Need achievable and Cheap Materials	All materials for the implementation of the idea are known and have long been used in production
11	Term Implementation of the idea Larger for 10 years	Term Implementation of the idea Larger for 5 years. The payback period of investments is longer 10 years	Term Implementation of the idea from 3 to 5 years. The payback period of investments is longer 5 years	Term Implementation of the idea Less 3 years. Payback period of investments from 3 to 5 years	The term of the idea Less 3 years. Payback period of investments Less 3 years

12	It is necessary to develop regulatory documents and obtain a large number of permits for the production and sale of the product	It is necessary to obtain a large number of permits for the production and sale of a product that requires significant funds and time	The procedure for obtaining permits for the production and sale of the product requires little money and time	It is only necessary to notify the relevant authorities about the production and sale Product	There are no regulatory restrictions on the production and sale of the product

The invited experts evaluated the intelligent module "Batch packaging tags" developed by us for automated printing of tags in the information system "Plasmis" in this way (see. Table. 5.2):

Table 5.2 – Results of the technological audit of the developed intelligent module (on a scale of assessment 0-1-2-3-4)

Criteria	Surname, initialsofexperts		
	Garmash V.V.	SofinaO.Yu.	Papinov V.M.
	Pointssetbyexperts:		
1	4	4	3
2	4	3	3
3	4	3	4
4	4	4	4
5	3	4	3
6	4	4	4
7	3	4	4
8	4	3	3
9	4	4	3
10	4	4	4
11	4	4	4
12	3	3	3
Sumofpoints	$СБ_1 = 45$	$СБ_2 = 44$	$СБ_3 = 42$
Arithmetic average sum of points $\overline{СБ}$	$\overline{СБ} = \dfrac{\sum\limits_{1}^{3} СБ_i}{3} = \dfrac{45+44+42}{3} = \dfrac{131}{3} = 43,67$		

The establishment of the commercial potential of the developed intelligent module "Tags party-packaging" will be carried out on the basis of the recommendations given in Table 5.3[28].

Table 5.3 – Levels of commercial potential of any scientific development

Arithmetic average of points , calculated on the basis of conclusions $\overline{СБ}$ Experts	Commercial level developmentpotential
0 – 10	Low
11 – 20	Belowaverage
21 – 30	Medium
31 – 40	Aboveaverage
41 – 48	High

Since the arithmetic average sum of points set by experts is 43.67 points, this indicates that the intelligent module "Tags party-packaging" developed by us for automated printing of tags in the information system "Plasmis" has a level of commercial potential, which is considered "high".

This is explained by the fact that the intelligent module developed by us significantly speeds up the quality of printing tags and provides automation of this process.

5.2 Calculation of the cost of developing an intelligent module "Tags"batch-container" for automated printing of tags in the information system PlasmIS

When developing an intelligent module, certain costs were made. Including:

A). Basic salary C_{of}developers, which is determined by the formula:

$$3_o = \frac{M}{T_p} \cdot t \quad \text{UAH, (5.1)}$$

where M – monthly official salary of the developer, UAH; we accept that

M = (6700... 20000) UAH/month;

T_p – the number of working days in a month; takeT_p = 22 days;

t – the number of days of work of developers.

The calculations made are reduced to Table 5.4:

Table 5.4 – Basic salaryofdevelopers

Name Posts Artist	Lunar Job salary, UAH	Payment for the working day, UAH	Number of days of work	Paymentcosts labor, UAH
1. Scientific supervisor of master's work	18000	818,18	20 Hours	≈ 2727
2. Undergraduate-student-performer	2000 (take 6700)	304,54	90	≈ 27408
3. Consultant on the economic part	16000	727,27	1,5 Hours	≈ 182 (at 6-hour workingday)
Generally				C_o = 30317 UAH

B). The additional salary of C_d developers is calculated as (10... 12)% of the value of their basic salary, i.e.:

$$З_д = \alpha \cdot З_о = (0{,}1...0{,}12) \cdot З_о \qquad . \qquad (5.2)$$

Accept that α = 0.1. Then for our case we get:

$$C_d = 0.1 \times 30317 = 3031.7 \approx 3023 \text{ UAH}$$

C). Accruals on the wages of the$_{NZP}$ $_{of}$ developers (researchers) are calculated by the formula:

$$НЗП_{зп} = (З_о + З_д) \cdot \frac{\beta}{100}, \qquad (5.3)$$

where β   is the rate of compulsory single contribution to state social insurance, %. β = 22%. Then:

$$NZN_{zp} = (30317 + 3032) \times 0.22 = 7336.78 \approx 7337 \text{ UAH}$$

D). Depreciation of fixed assets A, which were used in the performance of this work:

$$A = \frac{Ц \cdot Н_a}{100} \cdot \frac{T}{12} \qquad \text{UAH, (5.4)}$$

where C – total book value of fixed assets, UAH;

H a – annual rate of depreciation. For our case, we can assume that $Н_a$ = (5...25)%;

T – the term of use of fixed assets, months.

The calculations made are summarized in table 5.5.

Table 5.5 – Calculationofdepreciation

Name Equipment premises, etc.	Book value, UAH.	Depreciatio nrate, %	Termofuse, miss.	The amount of depreciation, UAH
1. Computer equipment, equipment, etc.	60000	25	3.5 (at 60% usage	2625
2. University premises, departments	20000	4	3,5 with 15% usage	35
Just				**A = 2660 UAH**

D). The cost of materials M is calculated by the formula:

$$M = \sum_{1}^{n} H_i \cdot Ц_i \cdot K_i - \sum_{1}^{n} B_i \cdot Ц_{в} \text{ UAH}, (5.5)$$

where Hi – material consumption of the i-th name, kg; C i – the cost of the material of the i-th name; K_i – coefficient of transport costs, $K_{and} = (1,1 ... 1,15)$; Bi – mass of waste material *of the*i-th name; C_{c} – the price of waste material of the i-th name; n – the number of types of materials.

E). The cost of components K is calculated by the formula:

$$K = \sum_{1}^{n} H_i \cdot Ц_i \cdot K_i \text{ UAH}, (5.6)$$

where H and – the number of components of the i-th type, pcs.; C and – the price of components *of*thei-th type; K_i – coefficient of transport costs, $K_{and} = (1,1 ... 1,15)$; n – the number of types of components.

During the work, the total cost of materials and components amounted to approximately 1500 UAH.

G). The cost of power electricity B_e is calculated by the formula:

$$B_e = \frac{B \cdot П \cdot Ф \cdot K_{п}}{K_{д}}, \qquad (5.7)$$

where B – cost of 1 kWh. electricity, in 2022 at $\approx$ UAH 3.0 / kW;

П – installed power of the equipment, kW; P = 1.2 kW;

Φ – the actual number of hours of equipment operation, hours.

Accept that F = 220 hours;

K_{p-} power utilization factor; $K_n < 1 = 0.79$.

$K_{\text{д}}$ – efficiency, $K_d = 0.66$.

Then the cost of power electricity will be equal to:

$$B_e = \frac{B \cdot \Pi \cdot \Phi \cdot K_{\text{п}}}{K_{\text{д}}} = \frac{3 \cdot 1,2 \cdot 220 \cdot 0,79}{0,66} = 948 \text{ UAH.}$$

I). Other expenses $B_{\text{інш}}$ can be taken as (50... 300)% of the basic salary of developers, i.e.:

$B_{\text{інш}} = (0.5....3) \times C_o.$ (5.8)

For our case, we get:

$$B_{\text{інш}} = 1.2 \times 30317 = 36380.4 \approx 36381 \text{ UAH.}$$

K). The sum of all previous items of expenditure is the cost of performing our work (directly by the developer-undergraduate) – B.

B = 30317 + 3032 + 7337 + 2660 + 1500 + 948 + 36381 = 82175 UAH.

L). The total costs of development and possible implementation of the intelligent module $B_{\text{заг}}$ developed by us are calculated by the formula:

$$B_{\text{заг}} = \frac{B}{\beta}, \qquad (5.9)$$

where is the coefficient that characterizes the stage (stage) of this work. It can be assumed that $\beta \approx 0.8$ [28], since the work needs minor refinement.

$$\text{Then: } B_{\text{заг}} = \frac{80183}{0,8} = 102718,75 \text{ and UAH (103 thousand UAH).}$$

That is, the projected total costs for the development and possible implementation of the intelligent module "Batch packaging" developed by us for automated printing of tags in the information system "PlasmIS" are approximately 103 thousand UAH.

5.3 Calculation of the economic effect of the possible commercialization of Development

The economic effect of the introduction and possible commercialization of the developed intelligent module "Batch packaging tags" for automated printing of tags in the information system "Plasmas" is explained by its much better functionality.Therefore, our development can be implemented on the market somewhat more expensive than similar development functions. So, if similar developments in 2022 cost about 30 thousand UAH on the market, then our development can be implemented for about 45 thousand UAH or 15 thousand UAH more expensive.

Analysis of market capacity shows that today in Ukraine the number of real users of such systems can be about 50 people annually. These are, first of all, various industrial enterprises, ranging from medium to large, etc. Therefore, we can expect an increase in demand for our development at least within 3 years after its implementation.

That is, if our development is implemented from January 1, 2024 (since it needs something to be improved), then its results will be revealed during 2024, 2025 and 2026.

The forecast of growth in demand for our development is by year:

a) 2024 – approximately +20 pcs. to the base year;

b) 2025 – +25 pcs. to the base year;

c) 2026 – +40 pcs. to the base year.

The possible increase in net profit that a potential investor can get from commercialization, that is, bringing our development to the market, $\Delta\Pi_i$ will be:

$$\Delta\Pi_i = \sum_{1}^{n} (\Delta Ц_o \cdot N + Ц_o \cdot \Delta N)_i \cdot \lambda \cdot \rho \cdot (1 - \frac{\upsilon}{100}), \qquad (5.10)$$

where $C\,o\Delta$ – improvement of the main quality indicator from the implementation of development results this year. For our case, this is an increase in the sale price of our development $\Delta\text{Ц}_o$= 45 - 30 = + 15 thousand UAH;

N – the main quantitative indicator that determines the volume of activity in the year before the implementation of the development results; N = 50 pcs.;

Δ N – improvement of the main quantitative indicator from the implementation of development results. Such an improvement will be by year, respectively: in 2024 – + 10 pcs., in 2025 +25 pcs., and in 2026 +40 pcs. (until the base year 2022);

C_o – the main quality indicator (i.e. price), which determines the volume of activity in the year after the implementation of the development results, UAH; C_o= 45 thousand UAH;

n – the number of years during which it is expected to receive positive results from the implementation of the development; for our case, n = 3;

λ – coefficient that takes into account the payment of value added tax; λ = 0,8333

ρ – a coefficient that takes into account the profitability of the product. It is recommended to take = (0.2...0.5); take = 0.5; $\rho\,\rho$

υ – income tax rate. In 2022-23 = 18%. In 2024, we also expect 18%. υ

Then the possible increase in net profit of $P\Delta_1$ for a potential investor during the first year from the possible implementation of our development (2024) will be:

$$\Delta\Pi_1 = [15\cdot 50 + 45\cdot 10]\cdot 0,8333\cdot 0,5\cdot(1-\frac{18}{100}) \approx 410\ \text{yew. UAH.}$$

A possible increase in net profit of $P\Delta_2$ for a potential investor from the possible implementation of our development during the second (2025) year will be:

$$\Delta\Pi_2 = [15\cdot 50 + 45\cdot 25]\cdot 0,8333\cdot 0,5\cdot(1-\frac{18}{100}) \approx 640\ \text{yew. UAH.}$$

A possible increase in net profit $P\Delta_3$ for a potential investor from the possible implementation of our development during the third (2026) year will be:

$$\Delta\Pi_3 = [15 \cdot 50 + 45 \cdot 40] \cdot 0,8333 \cdot 0,5 \cdot (1 - \frac{18}{100}) \approx 871 \text{ yew. UAH.}$$

The present value of growth of all net profits from the possible implementation of our development will be:

$$\Pi\Pi = \sum_1^{\tau} \frac{\Delta\Pi_i}{(1+\tau)^t}, \quad (5.11)$$

where – increase in net profit in each of the years during which the results of the work performed and implemented are revealed, UAH; $\Delta\Pi_i$

t – the period of time during which the results of the implemented work are revealed, years. For our case, t = 3 years;

τ – discount rate. Accept = 0.10 (10%); τ

t – the period of time from the moment of the beginning of the development of the intelligent module "Tags batch-packaging" for automated printing of tags in the information system "PlasmIS" to the moment of obtaining possible net profits.

Then the present cost of growth of all possible net profits of PE, which can be obtained by a potential investor from the commercialization of our development, will be:

$$\Pi\Pi = \frac{410}{(1+0,1)^2} + \frac{640}{(1+0,1)^3} + \frac{871}{(1+0,1)^4} \approx 339 + 481 + 595 = 1415 \text{ thousand UAH}$$

A possible increase in net profit of $P\Delta_2$ for a potential investor from the possible implementation of our development during the second (2025) year will be:

$$\Delta\Pi_2 = [15 \cdot 50 + 45 \cdot 25] \cdot 0,8333 \cdot 0,5 \cdot (1 - \frac{18}{100}) \approx 640 \text{ yew. UAH.}$$

A possible increase in net profit $P\Delta_3$ for a potential investor from the possible implementation of our development during the third (2026) year will be:

$$\Delta\Pi_3 = [15 \cdot 50 + 45 \cdot 40] \cdot 0,8333 \cdot 0,5 \cdot (1 - \frac{18}{100}) \approx 871 \text{ yew. UAH.}$$

The present value of growth of all net profits from the possible implementation of our development will be:

$$\Pi\Pi = \sum_1^T \frac{\Delta\Pi_i}{(1+\tau)^t}, \qquad (5.11)$$

where – increase in net profit in each of the years during which the results of the work performed and implemented are revealed, UAH; $\Delta\Pi_i$

t – the period of time during which the results of the implemented work are revealed, years. For our case, t = 3 years;

τ – discount rate. Accept = 0.10 (10%); τ

t – the period of time from the moment of the beginning of the development of the intelligent module "Tags batch-packaging" for automated printing of tags in the information system "PlasmIS" to the moment of obtaining possible net profits.

Then the present cost of growth of all possible net profits of PE, which can be obtained by a potential investor from the commercialization of our development, will be:

$$\Pi\Pi = \frac{410}{(1+0,1)^2} + \frac{640}{(1+0,1)^3} + \frac{871}{(1+0,1)^4} \approx 339 + 481 + 595 = 1415 \text{ thousand UAH}$$

The present value of PV investments to be invested to implement our development: PV = (1.0... 5) × In$_{zag}$.

For our case,

PV = (1.0... 5) × 103 = 2.5 × 103 = 257.5 ≈ 258 thousand UAH.

We calculate the absolute effect of the possible investment E$_{abs}$.

$$E_{abs} = PP - PV, \qquad (5.12)$$

where PE – the present value of increasing all net profits for the investor from the possible implementation of our development, UAH;

PV – the present value of investments PV = 258 thousand UAH.

The absolute effect of the possible implementation of our development (with a projected sales market) for three years will be:

$$E_{abs}= 1415 – 258 = 1157 \text{ thousand UAH.}$$

Since $E_{abs} > 0$, the commercialization of our development may be appropriate.

Next, we calculate the internal yield E_{in} the investment:

$$E_{в} = \sqrt[T_ж]{1 + \frac{E_{абс}}{PV}} - 1, \tag{5.13}$$

where E abs – absolute effect of investments; $E_{abs} = 1157$ thousand rubles. UAH;

PV – the present value of the initial investment PV = 258 thousand rubles. UAH;

T – development life cycle, years.

$T_f = 4$ years (2023, 2024, 2025, 2026)

For our case, we get:

$$E_{в} = \sqrt[4]{1 + \frac{1157}{258}} - 1 = \sqrt[4]{1 + 4,4845} - 1 = \sqrt[4]{5,4845} - 1 = 1,53 - 1 = 0,53 = 53\%.$$

Next, we determine the minimum yield, below which it will not be profitable for a potential investor to commercialize our development.

The minimum yield or minimum (barrier) discount rate of τ_{mines} is determined by the formula:

$$\tau_{мін} = d + f, \tag{5.14}$$

where d is the weighted average rate on deposit transactions in commercial banks; in 2022 in Ukraine d = (0.10...0.12);

f – an indicator characterizing the riskiness of investments; f = (0,05...0,30).

For our case, we get:

$$\tau_{min =} 0.12 + 0.30 = 0.42 \text{ or } \tau_{min} = 42\%.$$

Since the value of E in $= 53\% >_{\min} \tau = 42\%$, a potential investor, in principle, may be interested in financing and commercializing the intelligent module "Batch Container Tags" developed by us for automated printing of tags in the information system "PlasmIS".

Next, we calculate the payback period of funds invested in the possible commercialization of the intelligent module "Batch-packaging tags" developed by us for automated printing of tags in the information system "Plasmis".

The payback period T_{ok} is calculated by the formula:

$$T_{\text{ок}} = \frac{1}{E_{\text{в}}} \ . \qquad (5.15)$$

For our case, the payback period of T_{ok} funds will be:

$$T_{\text{ок}} = \frac{1}{0,53} = 1,89 \ \text{years} < 3 \ \text{years},$$

which indicates the potential feasibility of commercializing the intelligent module "Batch packaging tags" developed by us for automated printing of tags in the information system "Plasmas".

Next, a simulation of the dependence of the internal yield of invested potential investments on the level of inflation in the country is carried out. As you know, in the coming years, unfortunately, a high level of inflation is predicted (within 30% and above), which is caused by Russia's military aggression against Ukraine.

Taking the inflation rate of 30%, we get:

$$\text{ПП} = \frac{410}{(1+0,3)^2} + \frac{640}{(1+0,3)^3} + \frac{871}{(1+0,3)^4} \approx 243 + 291 + 305 = 839 \ \text{thousand UAH}$$

Then the absolute effect of the possible implementation of our development in three years will be:

$$E_{abs} = 839 - 258 = 581 \ \text{thousand UAH}.$$

The internal yield of E_{in} the investment will be:

$$E_{\text{в}} = \sqrt[T_{\text{ж}}]{1 + \frac{E_{\text{абс}}}{PV}} - 1 \qquad ,$$

where E abs – absolute effect of investments; E_{abs} = 581 thousand UAH;

PV – the present value of the initial investment PV = 258 thousand UAH.

$$E_{в} = \sqrt[4]{1 + \frac{581}{258}} - 1 = \sqrt[4]{1 + 2,2520} - 1 = \sqrt[4]{3,2520} - 1 = 1,343 - 1 = 0,343 = 34,3\%.$$
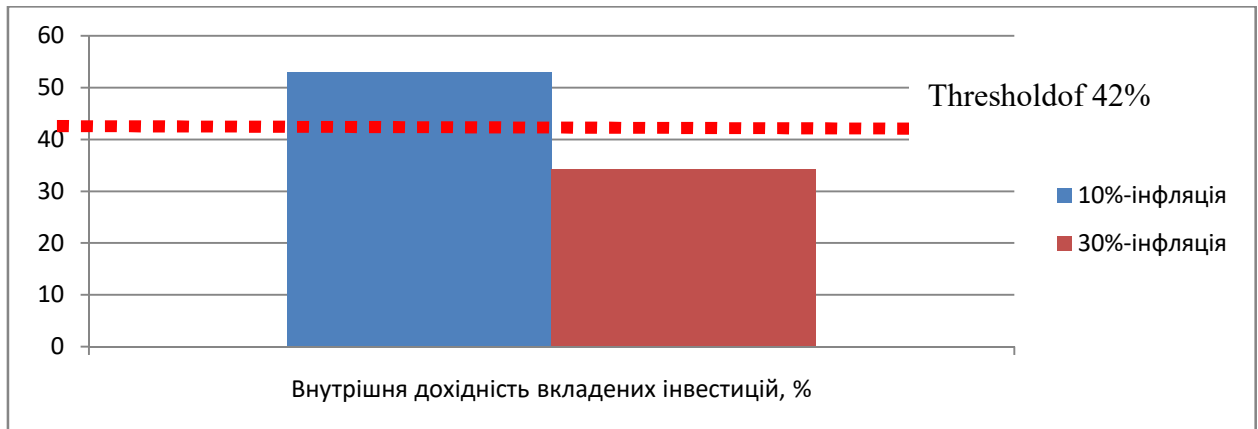
Figure 5.1 – Modeling the dependence of the value of internal field potential investments from the level of inflation in the country

Analysis of the graph in Figure 5.1 shows that at an inflation rate of 10%, the value of the internal return on investment is E in = 53%, which is greater than the threshold value of mines = 42% and therefore the commercialization of our development may be appropriate; at an inflation rate of 30%, the value of the internal return on investment invested in the commercialization of our development is $E\tau_{in}$ = 34.3%, which is less than the threshold value of $_{mines} \tau$ = 42%, and therefore the commercialization of our development (under the current conditions) will be problematic for the investor. To make a final decision, it is necessary to carry out additional justifications and calculations (for example, to reduce the level of risk taken, to raise the price of implementation of our development, etc.).

The results of the performed economic part of the master's qualification work are tabulated:

Indicators	Specifiedinthe TOR	Achieved in master's degree qualification work	Conclusion
1. Development costs	No more 120 thousand rubles. UAH	103 thousandrubles. UAH.	Achieved
2. Absolute the effect of the implementation of development (in the future value of money), thousands of UAH	Not less than 1100 thousand UAH (for three years)	1157 thousand UAH	Performed
3. Internal returnoninvestment, %	notlessthan 42%	53%	Achieved
4. Payback period of investments, years	upto 3 years	1,89 yearsold	Performed

Thus, the main technical and economic indicators of the intelligent module "Batch packaging tags" developed by us for automated printing of tags in the information system "PlasmIS",defined in the terms of reference, have been completed.

CONCLUTIONS

The completed master's qualification work is devoted to the automation of the process of printing labels from the "Batch-container labels" module of the "PlasmIS" information system. During the development of this intelligent module, the main attention was paid to the practical implementation of the universal method of printing tags, which includes printing tags with relevant data on paper of different sizes (formats A4, 100x100 mm, etc.).

An information model of automated tag printing was developed, as a result of which the relation of the tag printing model was presented in the form of a database scheme. A model of the product type knowledge base of the "Party-Container Tags" module has been developed, which provides an automated tag friend for any combination of data based on sets of production rules, predicates, functions and operators. A diagram of use cases and a sequence diagram of the unit's processes were developed and presented in the MCR. The choice of a technological environment for the development of an intelligent module is substantiated, the relevant software was obtained and successfully tested in production conditions.

The developed system is economically beneficial and, according to calculations, can bring an absolute income in the amount of UAH 1,157,000.

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ATTACHMENT

Attachment A(mandatory)

Вінницький національний технічний університет

_____
(повне найменування вищого навчального закладу)

Факультет інтелектуальних інформаційних технологій та автоматизації

_____
(найменування структурного підрозділу)

Кафедра автоматизації та інтелектуальних інформаційних технологій

_____
(найменування випускової кафедри)

ЗАТВЕРДЖУЮ
Завідувач кафедри АІІТ
_____ д.т.н., проф. О.В. Бісікало
        (підпис)
“__” _____ 2022 р.

ТЕХНІЧНЕ ЗАВДАННЯ
на магістерську кваліфікаційну роботу
«DEVELOPMENT OF THE INTELLIGENT MODULE "TAGS ABOUT
BATCH AND CONTAINERS" FOR AUTOMATED PRINTING OF TAGS IN
THE "PLASMIS" ERP SYSTEM»
08-02.МКР.000.11.000.ТЗ

Керівник магістерської кваліфікацій-
ної роботи
д.т.н., проф.
_____О.В. Бісікало
        (підпис)
“__” _____ 2022 р.

Розробив студент гр. 1АКІТ-21м
_____В. Ю. Старжинський
(підпис)
“__” _____ 2022 р.

Вінниця 2022

1. Підстава для проведення робіт

Підставою для виконання роботи є наказ № __ по ВНТУ від «__» _____ 2022 р., та індивідуальне завдання на МКР, затверджене протоколом № __ засідання кафедри АІІТ від «__» _____ 2022 р.

2. Джерела розробки:

- В.Ю. Старжинський, О.В. Бісікало. «Розвитокінформаційноїсистеми "ПлазмІС" на основіпорівняння з аналогами, »
в Матеріаликонференції «Молодь в науці: дослідження, проблеми, перспективи (МН-2022)», Вінниця, 2022. 3. Мета і призначення роботи
- Підвищення рівня автоматизації друку бірок і обліку відповідних даних шляхом розробки модуля "Бірки партія-тара" для діючої інформаційної системи "ПлазмІС".
- Старжинський, В.; Бісікало, О. Розробка модуля "Штрих-коди" в інформаційнійсистемі "ПлазмІС". LI НТКП ВНТУ. Факультет інтелектуальнихінформаційнихтехнологій та автоматизації, Ukraine, feb. 2022.
- Старжинський, В.; Бісікало, О.Модель автоматизованогооблікуматеріальнихресурсів у ERP-системі "ПлазмІС". 11-та Міжнароднанауково-технічнаконференція «ІНФОРМАЦІЙНІ СИСТЕМИ ТА ТЕХНОЛОГІЇ ІСТ-2022» 22-25 листопада 2022. Харків.

4. Вихідні дані для проведення робіт:

- методологічна та технологічна сумісність інтелектуального модуля здіючою на підприємстві ПрАТ "ПлазмаТек"ERP-системою "ПлазмІС";
- модель бази знань – система продукцій;
- автоматизація друку бірок для будь-яких комбінацій виробничих даних;
- технологічні засоби для програмної реалізації модуля – JavaScript, jQuery, Oracle APEX.

5. Методи дослідження:

системний аналіз, методи інженерії знань, зокрема побудова моделі знань на основі системи продукцій, аналізбізнес-процесів на виробництві, об'єктно-орієнтоване проектування, методи клієнт-серверної розробки програмного забезпечення.

6. Етапи роботи і терміни їх виконання

- a) Аналіз предметної області .... __.‾ __
- b) Розробка інтерфейсу.. __ ‾ __
- c) Реалізація обробки даних(редагування, видалення, додавання) __ ‾ __
- d) Розробка функціоналу друку бірок................................. __ ‾ __

7. Очікувані результати та порядок реалізації

Отримання системи друку бірок з партії-тари.

8. Вимоги до розробленої документації

Пояснювальна записка оформлена у відповідності до вимог «Методичних вказівок до виконання та оформлення магістерських кваліфікаційних робіт для студентів спеціальності 151– «Автоматизація та комп'ютерно–інтегровані технології»

9. Порядок приймання роботи

Публічний захист………………………………………………__.__.2022 р.

Початок розробки   «___» _____ 2022 р.

Граничні терміни виконання МКР   «___» _____2022 р.

Розробив студент групи 1АКІТ-21м   _____   СтаржинськийВ.Ю.

AttachmentB(mandatory) - The search filter code

```
select bc.bc_id, bc.bc_obi_ts, bc.bc_itpt, bc.bc_ist, bc.bc_grp, dgrp.dic_sna
me bc_grp_name, drst.dic_sname bc_rec_st_name,
  itm.itm_id, itm.itm_name_ukr_f, itpt.itpt_name2_f as itpt_namef, itpt.itpt_
dt, ipk.dic_sname,
  pck.pck_name,  ist.ist_num, ist.ist_name_ukr_f, itm.itm_itmg, pck.pck_id,
  --bc.bc_count,
  barcode_dm.calcCount4Barcode(p_bc_id => bc.bc_id) as bc_count,
  bc.bc_ius, ius.ius_name, bc.bc_dt, bc.bc_seal, bc.bc_comment, bc.bc_rec_st,
 lower (bc.bc_rec_st) bc_st_low , bc.bc_rec_dt,
  test_vstarzhynskyi.GetBarcode4BcId(p_bc_id => bc.bc_id) as barcode_val,
  pltec_common.GetDprFullName(ca.dpr_id, p_delim => '—
›', p_type => 7) as itpt_ca,   unt.unt_sname,
  (select ius_c.ius_id from item_unit_storage ius_c where ius_c.ius_itm = itm
.itm_id and ius_c.ius_unt = itm.itm_unt and ius_c.ius_coef = 1) ius_n,
  bc.bc_st, bst.dic_sname bc_st_name
from barcode bc
  inner join vm_item_part itpt on itpt.itpt_id = bc.bc_itpt
  inner join vm_item itm on itm.itm_id = itpt.itpt_itm
  inner join vm_ca ca on ca.dpr_id = itpt.itpt_ca
  inner join v_ddn_itpt_kind ipk on ipk.dic_value = itpt.itpt_kind
  inner join vm_item_storage ist on ist.ist_id = bc.bc_ist
  inner join dis_ndi.v_ndi_packing_ur pck on pck.pck_id = ist.ist_pck
  inner join item_unit_storage ius on ius.ius_id = bc.bc_ius
  inner join dis_ndi.v_ndi_unit_ur unt on unt.unt_id = ius.ius_unt
  inner join dis_pltec.v_ddn_rec_st drst on drst.dic_value = bc.bc_rec_st
  inner join dis_pltec.v_ddn_bc_st bst on bst.dic_value = bc.bc_st
  left join v_ddn_bc_grp dgrp on dgrp.dic_value =  bc.bc_grp

where 1 = 1
/*filter_condition_begin*/
    #=filter__bc_spc_subdpr#
    #=filter__bc_group#
    #=filter__bc_date#
    #=filter__bc_itm#
    #=filter__bc_num#
    #=filter__bc_pck#
    #=filter__bc_ist_con#
    #=filter__bc_spc#
    #=filter__bc_rec_date#
```

```
        #=filter__bc_rec_st#
/*filter_condition_end*/
```

Attachment C(mandatory) - The function of generating barcode

```
function GetBarcode4BcId (

p_bc_idbarcode.bc_id%type,
p_type          varchar2 default null  -- 'code128'

) return varchar2

Is

l_result        varchar2(4000);

begin

  select 'P' || bc.bc_itpt || 'S' || bc.bc_ist || 'B' || bc.bc_id as barcode
      into l_result
    from barcode bc
    where bc.bc_id = p_bc_id;

  if p_type in ('code128') then
    select barcode_dm.Code_128(A =>l_result) as barcode_128
        into l_result
      from dual;
  end if;

  return l_result;

exception

  when others then

raise_application_error(-20000,
dis_sys.dis_message_util.get_message(msgCOMMON_EXCEPTION,
'test_vstarzhynskyi.GetBarcode4BcId',
chr(10)|| 'p_bc_id = ' || p_bc_id || dbms_utility.format_error_stack ||
dbms_utility.format_error_backtrace));
                                      end;
```

Attachment D(mandatory) - The generating generating code

```
                              $div = $(`<div class="div_box"  id="print_tag"
style="display: flex; flex-direction:column; align-items: center; width: 100%;
font-size: 9pt;">
                    <div class="firm_code_div" style = 'display:flex; flex-
direction:row; justify-content: space-between; width: 100%;'>
                       <div class="" style = 'display: contents; align-items:
end; width: 100%;'>
                          ${value_img}
                       </div>
                    </div>
                    <div class="ITM_NAME PRINT"  style='display:flex; flex-
direction:row; justify-content:flex-start; width: 100%;'>
                         <div style="width: 30%; text-align-last: left; border:
solid; border-width: thin; " class="">
                            <div class="row_stl">${lang('Назва і марка')}</div>
                         </div>
                         <div style="width: 70%;text-align-last: left; border:
solid; border-width: thin;">
                         <div style="font-weight:bold; display: flex; align-items:
center;      padding-left:      3px;      height:100%;      width:      auto"
class="tag_valuerow_stl">${nvl(element.itm_name_f, '')}</div>
                         </div>
                    </div>
                    <div class="ITPT_NAME PRINT" style='display:flex; flex-
direction:row; justify-content:flex-start; width: 100%;'>
                         <div class="" style="width: 30%;text-align-last: left;
border: solid; border-width: thin;">
                            <div class="row_stl">${'№ ' + lang('партії')}</div>
                         </div>
                         <div style="width: 70%;text-align-last: left; border:
solid; border-width: thin;">
                         <div style="font-weight:bold; display: flex; align-items:
center;      padding-left:      3px;      height:100%;      width:      auto"
class="tag_valuerow_stl">${nvl(element.itpt_num, '')}</div>
                         </div>
```

```
                        </div>
                            <div class="IST_NAME PRINT" style='display:flex; flex-
direction:row; justify-content:flex-start; width: 100%;'>
                                <div class="" style="width: 30%;text-align-last: left;
border: solid; border-width: thin;">
                                    <div class="row_stl">${'№ ' + lang('тари')}</div>
                                </div>
                                <div style="width: 70%;text-align-last: left; border:
solid; border-width: thin;">
                                    <div style="font-weight:bold; display: flex; align-items:
center;       padding-left:       3px;       height:100%;       width:       auto"
class="tag_valuerow_stl">${nvl(element.ist_num, '')}</div>
                                </div>
                        </div>
                            <div class="BC_COUNT PRINT" style='display:flex; flex-
direction:row; justify-content:flex-start; width: 100%;'>
                                <div class="" style="width: 30%;text-align-last: left;
border: solid; border-width: thin;">
                                    <div class="row_stl">${lang('Кількість')}</div>
                                </div>
                                <div style="width: 70%;text-align-last: left; border:
solid; border-width: thin;">
                                    <div style="font-weight:bold; display: flex; align-items:
center;       padding-left:       3px;       height:100%;       width:       auto"
class="tag_valuerow_stl">${nvl(element.bc_count_kg, '')}</div>
                                </div>
                        </div>
                            <div class="PACK PRINT" style='display:flex; flex-
direction:row; justify-content:flex-start; width: 100%;'>
                                <div class="" style="width: 30%;text-align-last: left;
border: solid; border-width: thin;">
                                    <div class="row_stl">${lang('Кількість в упаковці,
шт')}</div>
                                </div>
                                <div style="width: 70%;text-align-last: left; border:
solid; border-width: thin; ">
                                    <div style="font-weight:bold; display: flex; align-
items:    center;    padding-left:    3px;    height:100%;    width:    auto"
class="tag_valuerow_stl">${nvl(element.bc_pack, '')}</div>
```

```
                            </div>
                        </div>
                            <div class="BC_DT PRINT" style='display:flex; flex-
direction:row; justify-content:flex-start; width: 100%;'>
                                <div class="" style="width: 30%;text-align-last: left;
border: solid; border-width: thin;">
                                    <div class="row_stl">${lang('Дата')}</div>
                                </div>
                                <div style="width: 70%;text-align-last: left; border:
solid; border-width: thin;">
                                    <div style="font-weight:bold; display: flex; align-items:
center; padding-left: 3px; height:100%; width: auto" class="tag_valuerow_stl">
${nvl(kendo.toString(kendo.parseDate(element.bc_dt), "dd.MM.yyyy"), '')}</div>
                                </div>
                            </div>
                            <div class="SPC_NAME PRINT" style='display:flex; flex-
direction:row; justify-content:flex-start; width: 100%;'>
                                <div class="" style="width: 30%;text-align-last: left;
border: solid; border-width: thin;">
                                    <div class="row_stl">${lang('Працівник')}</div>
                                </div>
                                <div style="width: 70%;text-align-last: left; border:
solid; border-width: thin;">
                                    <div style="font-weight:bold; display: flex; align-items:
center;       padding-left:       3px;       height:100%;       width:       auto"
class="tag_valuerow_stl">${nvl(element.spc_name, '')}</div>
                                </div>
                            </div>
                            <div class="ITPT_CA PRINT" style='display:flex; flex-
direction:row; justify-content:flex-start; width: 100%;'>
                                <div class="" style="width: 30%;text-align-last: left;
border: solid; border-width: thin;">
                                    <div class="row_stl">${lang('Постачальник')}</div>
                                </div>
                                <div style="width: 70%;text-align-last: left; border:
solid; border-width: thin;">
                                    <div style="font-weight:bold; display: flex; align-items:
center;       padding-left:       3px;       height:100%;       width:       auto"
class="tag_valuerow_stl">${nvl(element.ca_rcv, '')}</div>
```

```
                </div>
            </div>
                <div class="NEXT_STAGE PRINT" style='display:flex; flex-
direction:row; justify-content:flex-start; width: 100%;'>
                    <div class="" style="width: 30%;text-align-last: left;
border: solid; border-width: thin;">
                        <div class="row_stl">${lang('Наступний етап')}</div>
                    </div>
                    <div  style="width: 70%;text-align-last: left; border:
solid; border-width: thin;">
                        <div style="font-weight:bold; display: flex; align-
items:    center;    padding-left:    3px;    height:100%;    width:    auto"
class="tag_valuerow_stl"></div>
                    </div>
                </div>
                    <div  class="DUST  PRINT"  style='display:flex;  flex-
direction:row; justify-content:flex-start; width: 100%;'>
                    <div class="" style="width: 30%;text-align-last: left;
border: solid; border-width: thin;">
                        <div class="row_stl">${lang('%' + ' пилу')}</div>
                    </div>
                    <div style="width: 70%;text-align-last: left; border:
solid; border-width: thin;">
                        <div style="font-weight:bold; display: flex; align-
items:    center;    padding-left:    3px;    height:100%;    width:    auto"
class="tag_valuerow_stl"></div>
                    </div>
                </div>
                    <div  class="STAMP  PRINT"  style='display:flex;  flex-
direction:row; justify-content:flex-start; width: 100%;'>
                    <div class="" style="width: 30%;text-align-last: left;
border: solid; border-width: thin;">
                        <div class="row_stl">${lang('Штамп ВТК')}</div>
                    </div>
                    <div style="width: 70%;text-align-last: left; border:
solid; border-width: thin;">
                        <div style="font-weight:bold; display: flex; align-
items:    center;    padding-left:    3px;    height:100%;    width:    auto"
class="tag_valuerow_stl"></div>
```

```
                </div>
            </div>
            <div id='barcode' class="barcode"></div>
        </div>`);
```

ТОВАРИСТВО З ОБМЕЖЕНОЮ ВІДПОВІДАЛЬНІСТЮ «КЛЕВІС»
ТОВ «КЛЕВІС»

Пошт. адреса: вулиця Праведників світу, будинок №18, м. Вінниця, Вінницький р-н, Вінницька обл., 21036

Юр. адреса: вулиця Праведників світу, будинок №18, м. Вінниця, Вінницький р-н, Вінницька обл., 21036

тел:+38(067)432-36-07 e-mail:office@klevis.com.ua www.klevis.com.ua

АКТ
про впровадження результатів магістерської кваліфікаційної роботи
Старжинського Валерія Юрійовича
на тему

«Development of the intelligent module "Tags about batch and containers" for automated printing of tags in the "PlasmIS" ERP system»

Представлені матеріали англомовної магістерської кваліфікаційної роботи Старжинського В. Ю. свідчать про актуальність та перспективність отриманих результатів. Впровадження спеціального модуля для зберігання та обробки інформації у складському обліку при прийомі сировини чи виробництві напівфабрикатів та отримання готової продукції на підприємстві із можливістю друку бірок дозволяє запровадити унікальну ідентифікацію, полегшити та автоматизувати роботу працівників, швидко та зручно отримувати потрібну інформацію.

Доцільність впровадження даного інтелектуального модуля складського обліку на заводах групи компаній ПрАТ "Плазматек" обумовлена перевагами застосування сучасних технологій з метою пришвидшення процесу прийому сировини на склад, ведення процесу виробництва та забезпечення повноцінного доступ до потрібних даних як робочого місця працівників, так і з мобільних пристроїв. Саме це, з огляду на виробничі потреби, й обумовлює цінність наукових результатів та практичних засобів, отриманих Старжинським В.Ю. за результатами проведеного дослідження.

Цим засвідчую, що з липня 2022 року програмне забезпечення інтелектуального модуля "Бірки партія-тара", розробленого Старжинським В.Ю., було впроваджено та пройшло успішну апробацію на заводах ТОВ "АллТрейд" (м. Бердичів), ПрАТ "Плазматек" (с.м.т. Рудниця) та ТОВ "Monolith Asia"(м. Ташкент, Узбекистан). Даний акт не є підставою для фінансових взаємозобов'язань між ТОВ «КЛЕВІС» та Старжинським В.Ю.

Директор _____ Кудрик В.В.

ПРОТОКОЛ ПЕРЕВІРКИ НАВЧАЛЬНОЇ (КВАЛІФІКАЦІЙНОЇ) РОБОТИ

Назва роботи: *Комплексна магістерська кваліфікаційна робота*
"Development of the intelligent module "Tags about batch and containers" for automated printing of tags in the "PlasmIS" ERP system"
Частина 2. Технічне проектування

Тип роботи: кваліфікаційна робота

(кваліфікаційна робота, курсовий проект (робота), реферат, аналітичний огляд, інше – зазначити)

Підрозділ: кафедра АІІТ, ФІІТА, 1АКІТ-21м

(кафедра, факультет, навчальна група)

Науковий керівник: Бісікало О.В., проф. каф. АІІТ

(прізвище, ініціали, посада)

Показники звіту подібності

Plagiat.pl (StrikePlagiarism)		Unicheck	
КП1	-	Оригінальність	98.7%
КП2	-		
Тривога/Білі знаки	/	Схожість	1.3%

Аналіз звіту подібності (відмітити потрібне)

X Запозичення, виявлені у роботі, оформлені коректно і не містять ознак плагіату.

Заявляю, що ознайомлений (-на) з повним звітом подібності, який був згенерований Системою щодо роботи (додається)

Автор _____Старжинський В. Ю.
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Опис прийнятого рішення: Допустити до захисту

Особа, відповідальна за перевірку _____ Маслій Р. В.
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