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DEVELOPMENT OF INFORMATION TECHNOLOGY TO SUPPORT DECISION MAKING FOR SYSTEMIC AND STRATEGIC ANALYSIS OF JSC «UKRZALIZNYTSYA»

РОЗРОБЛЕННЯ ІНФОРМАЦІЙНОЇ ТЕХНОЛОГІЇ ПІДТРИМКИ ПРИЙНЯТТЯ РІШЕНЬ ДЛЯ СИСТЕМНОГО ТА СТРАТЕГІЧНОГО АНАЛІЗУ АТ «УКРЗАЛІЗНИЦЯ»

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Abstract. The paper proposes an information technology for a decision support system (DSS) designed for systemic and strategic analysis of JSC «Ukrzaliznytsia» (Ukrainian Railways). The aim of the study is to develop a comprehensive automated information system that integrates modern methods of qualitative and quantitative data analysis to enhance the efficiency of business process management, risk assessment, and strategic planning within the railway industry.

The object of the research is a decision support system for systemic and strategic analysis at JSC «Ukrzaliznytsia», encompassing data analysis methods, system architecture, and mechanisms for integration with other corporate information systems. The authors provide a detailed description of the architecture and functionality of the proposed DSS, which consists of three levels: the data level (collection, processing, and storage of information from various internal and external sources), the analysis level (qualitative and quantitative analysis using state-of-the-art methods and tools), and the decision-making level (data visualization, reporting, and recommendations). Additionally, the paper outlines groups of methods for each subsystem, as well as software tools and technologies that can be employed to implement the DSS information technology.

To select optimal decisions based on specified criteria, modern analytical methods are utilized, including artificial intelligence, machine learning, and econometric models, enabling effective trend forecasting and risk evaluation. The proposed DSS information technology facilitates improved integration with other company information systems, ensuring seamless data exchange and eliminating duplication. The implementation of this system is expected to enhance the competitiveness of «Ukrzaliznytsia» at both national and international levels.

Future research directions include expanding the system's functional capabilities, particularly through the application of deep learning and blockchain technologies to ensure transparency and security in information processes. The development of new analytical methods will also contribute to improving forecasting accuracy and strategic adaptability.

Keywords: information technology, decision support system, qualitative and quantitative data analysis, strategic analysis, machine learning.

Problem Statement.

Modern automated information systems are primarily designed using a hybrid IT infrastructure that consists of a local (private) server-based IT infrastructure and a public cloud or hybrid cloud services built according to SOAP, XML-RPC, and JSON-RPC protocols [1], among others. In Europe and Ukraine, numerous portal solutions have been developed in recent years, including those for the automated provision of public services. Notable examples include the pan-European public sector information repository (https://data.europa.eu/en), the Unified State Services Portal of Ukraine (https://diia.gov.ua/), and others. A common feature of these solutions is the use of workflow automation processes, cloud-based solutions for business process automation (commerce, service, and sales), and an IT architecture interface layer with artificial intelligence support. This enables real-time data synchronization and the creation of a comprehensive customer profile, enhancing decision-making processes and predictive analytics.

JSC «Ukrzaliznytsia» is the largest infrastructure company in Ukraine and the country's biggest employer, operating complex business processes. The automation of passenger and freight transportation, financial planning, and infrastructure management requires the integration of advanced information technologies to support decision-making at various levels. This technology, designed within a unified IT infrastructure for the railway sector, must include a decision support system that incorporates both qualitative and quantitative analytical methods, ensuring a comprehensive assessment of business processes, risk factors, and strategic alternatives. However, existing automated information systems in the public sector either fail to provide multi-criteria decision-making support or lack such functionality altogether, not to mention risk assessment and scenario analysis. This complicates the alignment of strategic planning with national infrastructure policies and global transportation trends.

Thus, the development of an information technology solution in the form of a decision support system for systemic and strategic analysis, capable of processing data from various systems and making decisions based on expert evaluations and strategic analysis methods, is a relevant and necessary topic.

Analysis of Recent Research and Publications.

A review of the literature and recent studies on the development of decision support systems (DSS) for transportation management highlights the growing importance of artificial intelligence (AI), machine learning (ML), and big data analytics in optimizing railway operations. In [2], researchers demonstrate the effectiveness of predictive maintenance for railway infrastructure using AI, leading to cost reduction and increased service reliability. Study [3] proposes an architecture for big data analysis in transportation systems, addressing data integration and privacy challenges. This research emphasizes the role of qualitative and quantitative data analysis subsystems in enhancing decision-making efficiency for large-scale transportation networks. In [4], the authors explore various methods for optimizing business processes, particularly through risk assessment and quantitative data analysis, to design an information technology solution for railway IT infrastructure. The use of modern artificial intelligence and machine learning methods for developing decision support systems in railway operations, particularly for predictive maintenance and transportation process optimization, is presented in [5]. Studies [6] and [7] introduce the development of DSS for railway freight transport optimization while considering risk assessment in railway systems, integrating safety and economic factors.

Among domestic research, the fundamental works of Professor P. I. Bidiuk deserve special mention. In his textbook [8], he presents a methodology for designing decision support information systems based on modern principles of system analysis and strategic planning. The book also examines functional structures and alternative approaches to DSS implementation using various design models. An analysis of studies in this field indicates the development of railway decision-making systems that combine expert evaluations with AI-based quantitative analysis, ensuring a holistic approach to strategic and systemic railway management.

The aim of this research is to develop an information technology solution for decision support in the systematic and strategic analysis of JSC «Ukrzaliznytsia». This article focuses on creating a comprehensive system that integrates modern qualitative and quantitative data analysis methods to enhance business process management, risk assessment, and strategic planning in the railway sector.

Presentation of the Main Material.

To achieve the stated goal and address decision-making challenges across various business processes integrated into a unified IT infrastructure via hybrid cloud services, a modular decision support system (DSS) has been proposed. A key feature of this system is its multi-layered data analysis structure, which includes a primary data collection and processing subsystem, a qualitative and quantitative data analysis subsystem, an indicator grouping subsystem, and an information-analytical platform for scenario analysis. These subsystems reflect the structural-functional processes and business logic of the decision support system. The analysis of optimal decision selection takes into account predefined goal criteria, statistical data, and specified indicators of the company's qualitative development dynamics.

Subsystem for Primary Data Collection and Processing.

The primary data collection and processing subsystem is a fundamental component of the decision support system (DSS) for the systemic and strategic analysis of JSC «Ukrzaliznytsia» Its primary objective is to ensure the timely, accurate, and comprehensive collection of data from various sources, its preliminary processing, and preparation for further analysis. The quality of input data processing directly influences the effectiveness of decision-making and the performance of other subsystems: incomplete, inaccurate, or outdated data can lead to erroneous conclusions and inefficient management decisions.

The data collection process involves recording and accumulating information from a wide range of sources, including internal and external information flows. Internal sources encompass train movement automation systems, dispatch control, freight accounting, scheduling and planning systems, financial records, as well as databases related to infrastructure, rolling stock, and personnel. Additionally, reports on operational activities, technical documentation, and audit results play a crucial role. External sources include data from the State Statistics Service of Ukraine, the Antimonopoly Committee, the State Transport Safety Service, the Ministry of Infrastructure, and other relevant institutions. Furthermore, this category includes information on market competition, suppliers, clients, and contractors. A key element of this subsystem is its ntegration with governmental information resources, allowing access to additional analytical data while ensuring compliance with legislative requirements.

Data collection methods vary depending on the data source and its characteristics. Automated data collection is facilitated through integration with internal systems via APIs, ETL (Extract, Transform, Load) processes, web scraping, and open data analysis. Additionally, manual data collection methods, such as report processing, surveys, interviews, and expert consultations, are employed. To enhance data quality at the collection stage, mechanisms for filtering, verification, and deduplication are implemented.

Following collection, data undergoes preliminary processing, including cleaning, transformation, and standardization for subsequent analysis. This stage involves duplicate removal, error correction, missing value imputation, data normalization, and aggregation. Data is then stored in centralized data warehouses or specialized databases, ensuring quick access and analytical processing. A critical aspect of this process is data quality control, which guarantees accuracy, completeness, and consistency. Initial data assessment is performed using expert methods such as brainstorming, STEEP, and SWOT analysis, which help identify potential risks and optimal management solutions. Data reliability is evaluated using Miller's scale, allowing the elimination of incorrect or insufficiently precise data.

To implement this subsystem, modern information technologies are proposed, including Oracle database management systems, ETL tools such as Informatica PowerCenter, Talend Open Studio, Apache Kafka, and programming languages such as Python, Java, and R for data processing and algorithm development. Data visualization and analytics can be performed using Power BI, Tableau, or Qlik Sense, while hybrid cloud technologies such as AWS, Azure, or Google Cloud are recommended for storing and processing large datasets. Information security is ensured through access control systems and cryptographic protection mechanisms.

A user-friendly interface is a critical functional component of the subsystem, enabling data access, processing, and analytical report viewing. In the three-tier IT architecture, artificial intelligence (AI) is proposed for use in the interface layer to adapt to different user categories, including executives, analysts, and operational personnel, each requiring different levels of data detail. Additionally, the subsystem should incorporate performance monitoring mechanisms and automated issue detection to ensure stable operation.

The proposed structure of the primary data collection and processing subsystem is presented in Figure 1.

Subsystem for Data Quality Analysis.

A key component of the information technology for decision support proposed by the authors is the qualitative data analysis subsystem. For JSC «Ukrzaliznytsia», it performs the function of strategic analysis, forming alternative development scenarios, and assessing risk factors. Additionally, it focuses on identifying patterns, trends, and cause-and-effect relationships in the data collected by the primary data collection subsystem, using a wide range of analytical methods for a deep understanding of the context and forecasting the development of events. The main goal of such analysis embedded in the information technology is to ensure the qualitative analysis of information. Together with the methods of the quantitative data analysis subsystem, this allows for the assessment of latent issues, risks, and opportunities, forming effective management strategies and making informed decisions.

The analysis process uses five groups of different methods: expert evaluation methods, strategic analysis methods, uncertainty analysis and probabilistic forecasting methods, big data processing methods, and creative analysis methods. These include techniques such as SWOT analysis, STEEP analysis, cognitive modeling, expert assessment methods, the Delphi method, Analytical Hierarchy Process (AHP), as well as probabilistic forecasting methods, including Bayesian models and scenario analysis. Using these approaches allows for assessing the strengths and weaknesses of the company, identifying the impact of external factors, predicting market changes, and evaluating potential risks. In addition, qualitative analysis methods can include content analysis, which involves automated and manual processing of textual sources, social media analysis, and entity extraction through Natural Language Processing (NLP) techniques. Data grouping and classification contribute to the systematization of large amounts of information.

An important role in the subsystem's operation is played by the interactive interaction group, consisting of qualified experts, analysts, and department heads. This group ensures the collection, discussion, and analysis of data, preparation of development scenarios, risk assessment, and adjustment of the company's strategic decisions. Using collective analysis methods such as brainstorming and cross-impact analysis helps obtain the most objective conclusions regarding possible directions of development. Additionally, the subsystem enables the assessment of the likelihood of different scenarios, taking into account their economic, social, and environmental impact, which is crucial in the process of long-term strategic planning. The results of the qualitative analysis are transferred to the corporate database, which is integrated with the quantitative analysis subsystem for further mathematical modeling and calculations. To ensure the reliability and validity of the results, methods of data triangulation and intersubjective validation can be used in the qualitative data analysis subsystem.

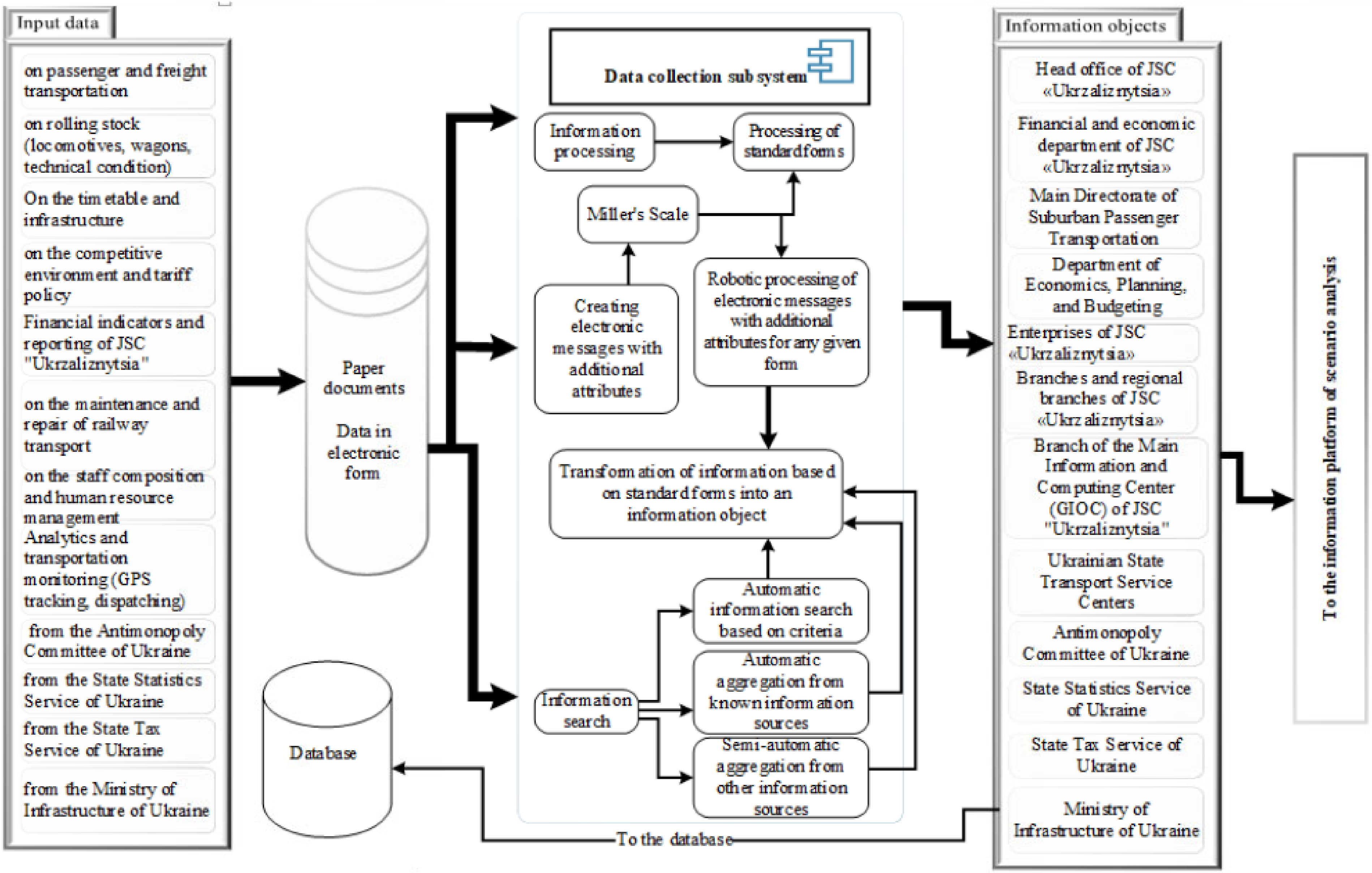

Figure 1 – Primary information collection and processing subsystem
Рисунок 1 – Підсистема збору та обробки первинної інформації

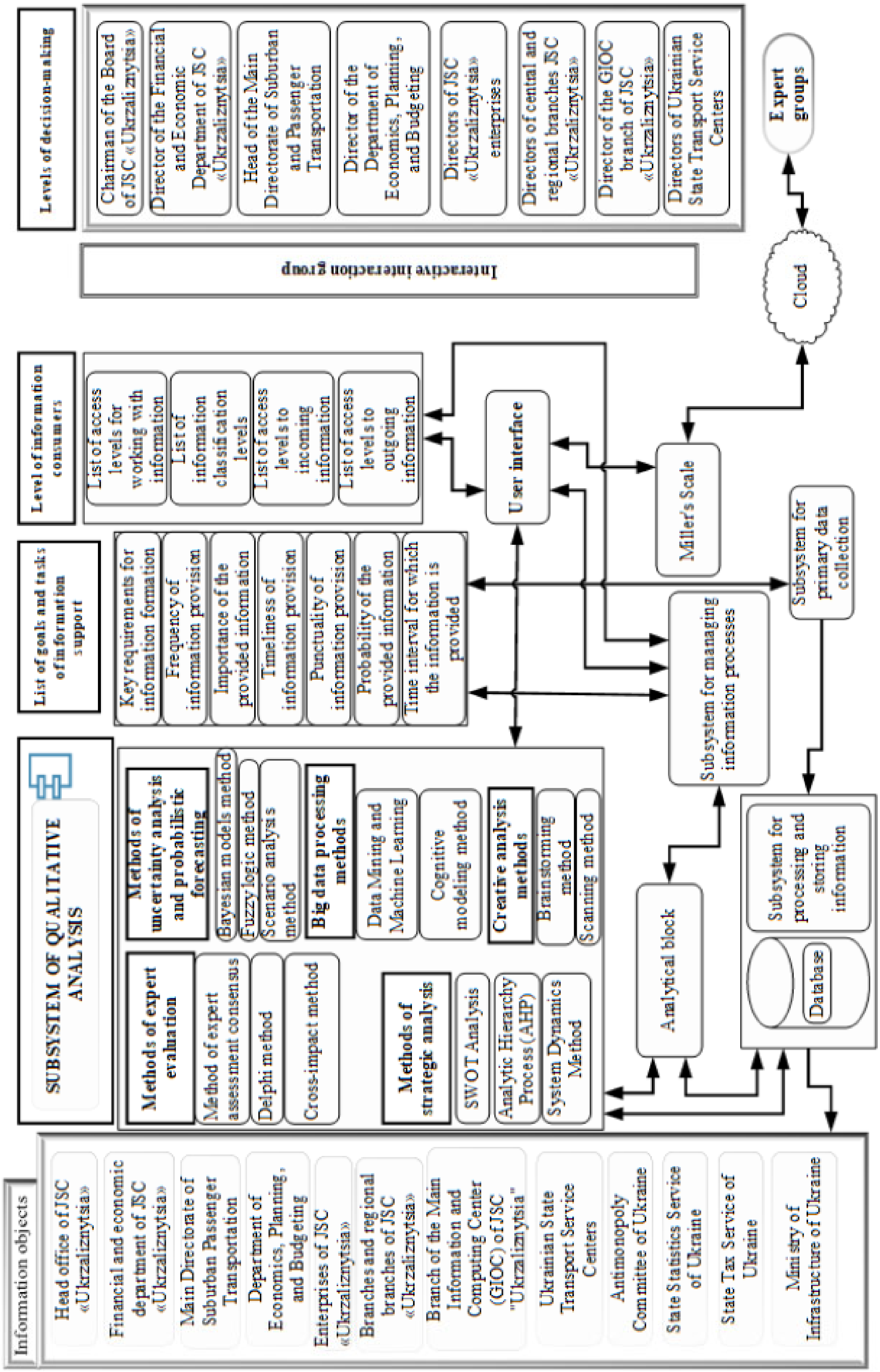

Figure 2 – Subsystem for qualitative analysis
Рисунок 2 – Підсистема якісного аналізу

Modern technologies and tools can be used to implement the qualitative analysis subsystem, including software components for text analysis (NLTK, spaCy, Stanford CoreNLP) and data visualization tools (Tableau, Power BI, Gephi). Specialized platforms for coding and qualitative data analysis (NVivo, ATLAS.ti) can also be employed. Furthermore, cloud computing platforms such as AWS, Azure, and Google Cloud Platform provide efficient processing of large volumes of data and scalability of the subsystem.

The scheme of the proposed qualitative data analysis subsystem is shown in Figure 2.

Subsystem for Quantitative Data Analysis.

The third component of the proposed information technology for decision support is the quantitative analysis subsystem. It performs mathematical risk assessment, analysis of alternative scenarios, and forecasting of key indicators based on statistical and econometric methods. The main task of the subsystem is to process data using formal analysis methods, allowing the company's management to make informed decisions focused on effective business process management, financial management, and strategic development.

A key stage of the subsystem's operation is the risk assessment associated with each potential development scenario. Simulation modeling is used for this, allowing the prediction of possible changes in the company's external and internal environment. Various econometric analysis methods are applied during the process, including correlation-regression analysis, statistical analysis, time series methods (AR, MA, ARMA, ARIMA models), exponential smoothing, as well as neural networks and machine learning algorithms. These methods allow not only the assessment of the current state of business processes but also the forecasting of the development of the company's key performance indicators.

The quantitative analysis subsystem uses a system for grouping indicators, which forms the basis of a balanced system for assessing the company's performance. It divides the indicators into four main categories: financial indicators, customer indicators, business process efficiency indicators, and learning and development indicators. Financial indicators include parameters such as profitability, liquidity, financial stability, and asset turnover. Customer indicators encompass passenger and cargo shipper satisfaction levels, service quality, and application processing speed. Business process indicators assess innovation potential, risks, and strategic development directions, while learning and development indicators define staff training levels, training hours, the effectiveness of new technology implementation, and employee motivation.

Based on the analysis of the collected data, the subsystem performs multi-criteria assessment of development scenarios, determines the confidence level for each scenario, and generates final analytical reports. An important component is the use of Monte Carlo methods for simulating random processes and evaluating the probabilities of different development scenarios. Additionally, morphological analysis, optimization methods, and trend analysis are used to form the most effective strategic decisions.

The interaction of the quantitative analysis subsystem with other modules in the decision support system occurs through a database containing structured and processed information. The subsystem receives data from the primary data collection subsystem and the qualitative analysis subsystem, supplementing them with mathematical evaluations and forecasting calculations. The results of the quantitative analysis are provided to the company's management and used for assessing the effectiveness of strategic planning, financial management, and operational process optimization.

The scheme of the proposed quantitative data analysis subsystem is shown in Figure 3.

Structural and Functional Diagram of the Decision Support System.

The structural and functional diagram of the Decision Support System (DSS) for JSC «Ukrzaliznytsia» represents a comprehensive multi-level architecture that ensures effective strategic and systemic analysis of the company's activities. The main goal of the DSS is to improve decision-making quality, assess the effectiveness of business processes, monitor risks, and forecast possible development scenarios for the company.

The DSS consists of several key subsystems, each of which performs specific tasks but interacts closely with other components. The first level of the structure is the subsystem for primary data collection and processing, which is responsible for registering, accumulating, transferring, and preliminary evaluating data. The information comes from various sources, including sensors, automated accounting systems, databases from government agencies, internal reports of the enterprise, and expert assessments. After collection, it undergoes filtering, structuring, and evaluation of critical parameters.

The second level is the qualitative analysis subsystem, which consists of five groups of different methods: expert evaluation methods, strategic analysis methods, uncertainty and probabilistic forecasting methods, big data processing methods, and creative analysis methods. This subsystem uses strategic analysis methods, including SWOT, STEEP, the Delphi method, hierarchical analysis, scenario analysis, and cognitive modeling. It generates alternative development scenarios, assesses risks, and determines the level of trust in certain decision options. An important role in its functioning is played by the interactive interaction group, consisting of experts, analysts, and managers of structural units, who conduct discussions, form conclusions, and adjust management strategies based on the obtained data.

The next level is the quantitative analysis subsystem, which performs mathematical processing of information, evaluates risks, conducts statistical and correlation-regression analysis, builds econometric models, and forecasts using time series (AR, MA, ARMA, ARIMA models). It also applies optimization methods, trend analysis, Monte Carlo methods, neural networks, and machine learning algorithms to assess the probability of certain scenarios and search for optimal solutions for the company.

The indicator grouping subsystem is the foundation of the balanced scorecard system used by the quantitative analysis subsystem and serves as the base for the entire DSS. It is an extended classifier for collecting, accumulating, and processing all the company's information based on predefined criteria to address the outlined tasks. The subsystem is divided into four components: the financial component (assessment of profitability, liquidity, financial stability), the customer component (analysis of service quality and customer satisfaction), the business processes component (assessment of innovation level, strategic directions, and risks), and the learning and development component (evaluation of staff competency, effectiveness of new technology implementation, and employee motivation).

A special role in the structural and functional diagram is played by the information-technical platform for scenario analysis. This platform is a set of methodological, organizational-technical, mathematical, structural-process, and technological methods and tools that enable effective interaction between experts, system operators, technical personnel, and specially created software and hardware. The information-technical platform has three hierarchical levels: the technological management level of the system, the system-organizational level, and the analytical level. It ensures interaction between subsystems and the integration of the obtained results into the decision-making process.

The DSS also includes a data repository that ensures the storage, processing, and integration of information from various sources. This repository stores both structured (digital databases, electronic documents) and unstructured (analytical reports, expert conclusions) data. Information in the system is divided according to access levels based on user classification: JSC «Ukrzaliznytsia» management, the financial and economic department, the economics, planning, and budgeting department, the main department of suburban passenger transportation, regional branches, the Antimonopoly Committee of Ukraine, the State Statistics Service, and the Ministry of Infrastructure.

Due to its clear structural and functional diagram, the decision support system allows the integration of large volumes of data, the application of modern analytical methods, the formation of alternative development scenarios, and ensures effective strategic management of JSC «Ukrzaliznytsia's» activities. It improves forecasting accuracy, reduces risks, and facilitates well-founded management decision-making, which is critically important for the development of the enterprise.

The proposed structural and functional diagram of the decision support system is shown in Figure 4.

Conclusions and Prospects for Further Research.

This paper proposes an information technology for decision support in the systemic and strategic analysis of JSC «Ukrzaliznytsia». The uniqueness of this technology lies in its comprehensive tool for improving management processes and decision-making, based on the integration of subsystems for primary data collection and processing, qualitative and quantitative data analysis, and the information-technical platform for scenario analysis. The structure of these subsystems is described in detail in the paper, with diagrams illustrating their organization.

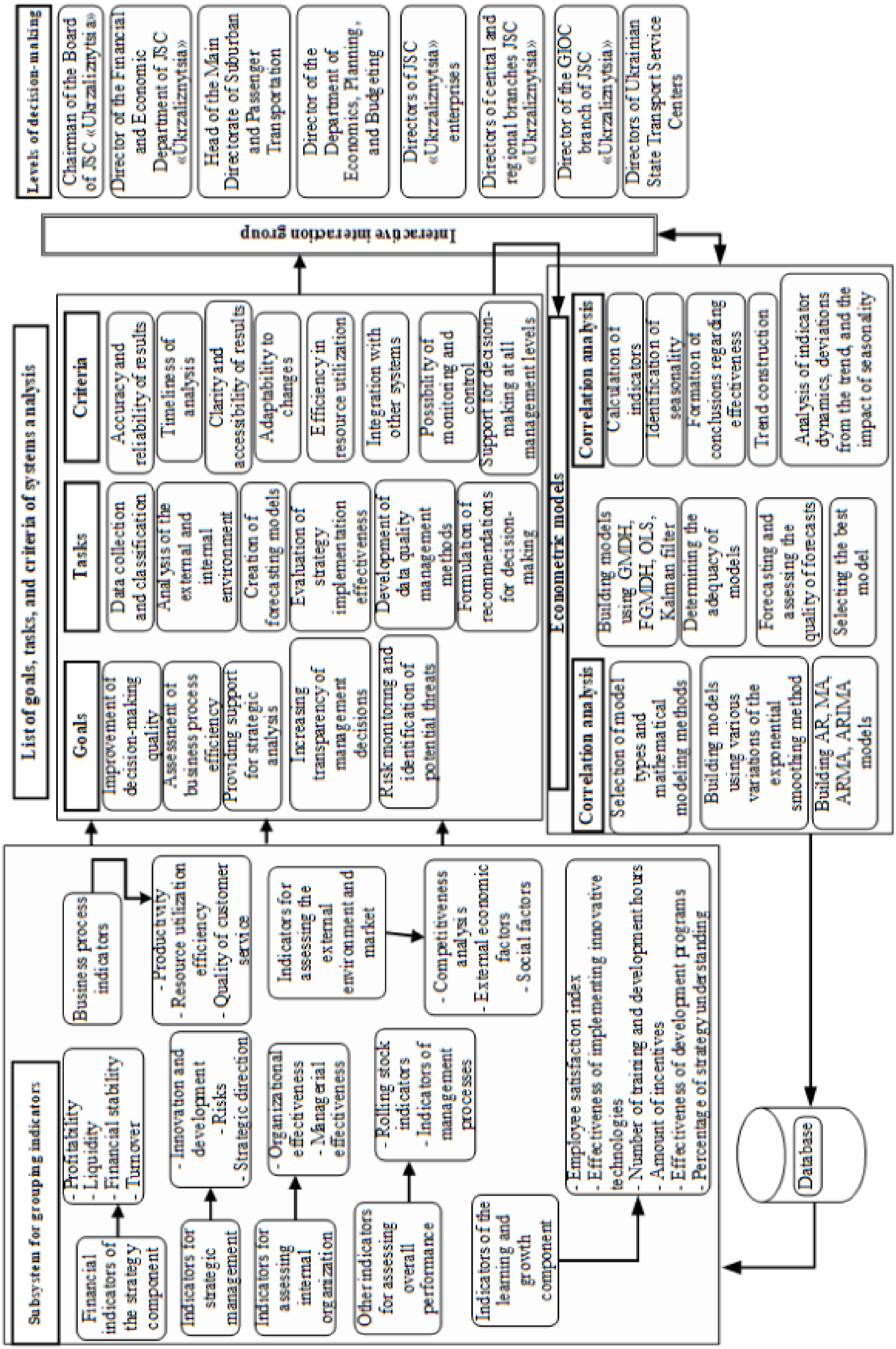

Figure 3 – Subsystem for quantitative analysis
Рисунок 3 – Підсистема кількісного аналізу

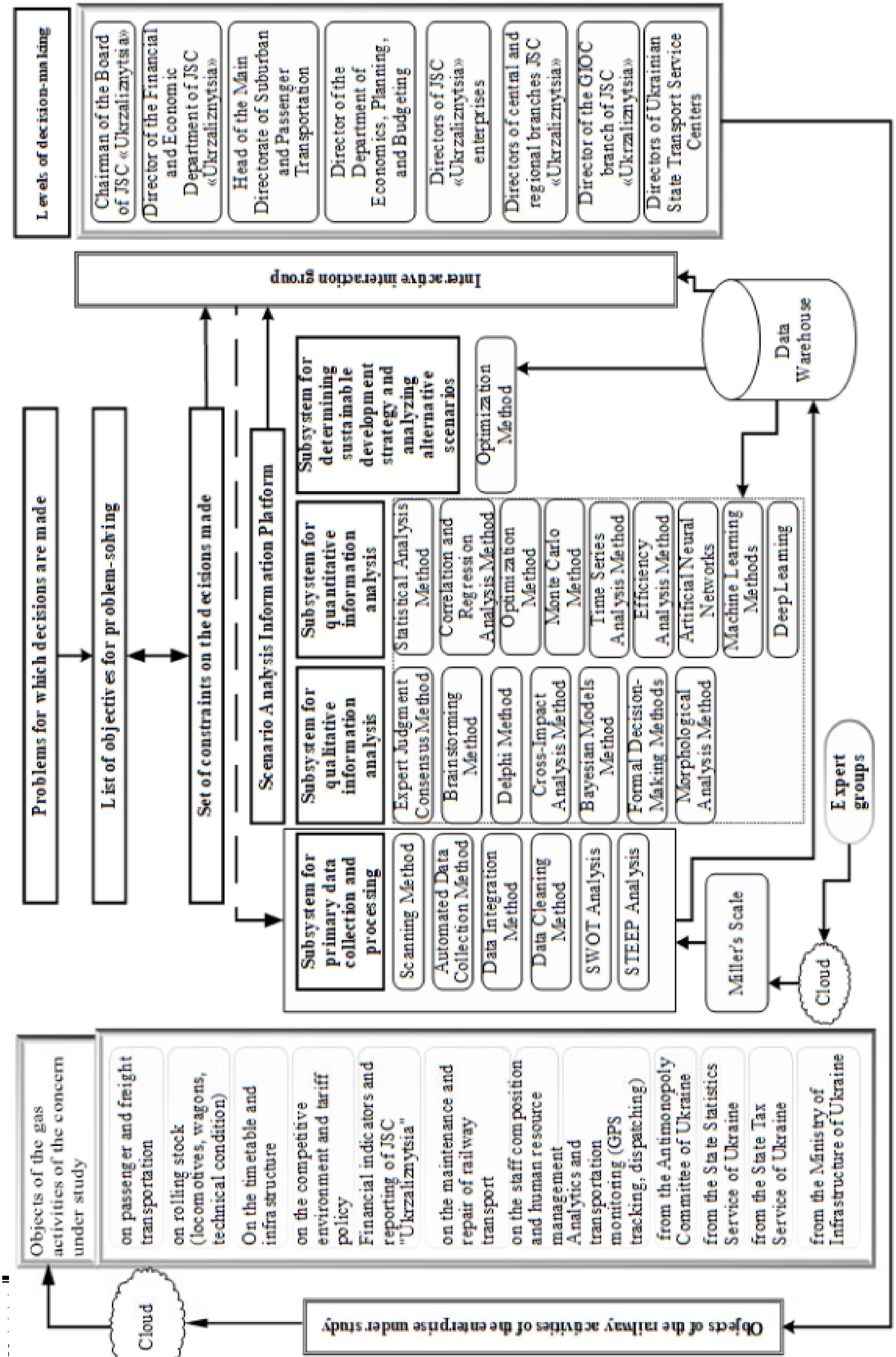

Figure 4 – Structural and functional diagram of a decision support system
Рисунок 4 – Структурно-функціональна схема системи підтримки прийняття рішень

Furthermore, the proposed information technology allows for the integration of advanced analytical methods, including artificial intelligence, machine learning, and econometric models, providing a comprehensive approach to evaluating business processes, analyzing risks, and generating alternative development scenarios. Its effectiveness is derived from the ability to conduct objective analysis of large volumes of data from various sources, identify hidden patterns, and forecast future trends. The implementation of this system will contribute to enhancing the company's management efficiency, improving strategic planning, and aligning operational activities with national infrastructure policies and global transport trends

.The integration of the proposed DSS with other information systems at JSC «Ukrzaliznytsia» will ensure full data exchange, prevent duplication, and, most importantly, facilitate the identification of potential problems and risks at early stages for timely response.

Prospects for Further Research include expanding the system's functional capabilities through the introduction of artificial intelligence methods, such as machine learning and deep learning, which could significantly improve the DSS's forecasting abilities in the areas of passenger and freight flow prediction, resource planning optimization, and the development of adaptive management strategies for railway transport. Additionally, there are plans to expand modeling capabilities by analyzing scenarios based on the «what-if» principle, and to further evaluate interdependencies among various elements of the system.

Further research should also focus on improving forecasting accuracy by developing new analytical methods that account for unpredictable external factors. Another promising direction for future research is the potential use of blockchain technology to enhance the transparency and security of information processes.

References

1. Zinchenko, A. Y. (2023). Design of distributed information systems based on using the technology of loosely coupled components. *Systems and Technologies*, *63*(1), 5-14. https://doi.org/10.32782/2521-6643-2022.1-63.1 [in Ukrainian].

2. Zhang, Y., Yang, G., Jiang, H., & Wang, W. (2021). A Survey on Data-Driven Predictive Maintenance for the Railway Industry. *Sensors*, 21(17), 5739. https://doi.org/10.3390/s21175739 [in English].

3. Smith, J., & Lee, B. (2020). An Improved Big Data Analytics Architecture Using Federated Learning for Transportation Systems. *Sustainability*, 15(21), 15333. https://doi.org/10.3390/su152115333 [in English].

4. Srinivasan, P., & Shaw, J. (2021). *Optimization Methods for Railway System Planning: A Systematic Literature Review.* Transport Research Part C: Emerging Technologies, 122, 102877. https://doi.org/10.1016/j.trc.2020.102877 [in English].

5. Hsu, C.-H., & Liu, Y.-L. (2020). *Application of Artificial Intelligence in Railway System Decision Support.* Journal of Transportation Engineering, 146(7), 04020049. https://doi.org/10.1061/(ASCE)TE.1943-5436.0000731 [in English].

6. Zhao, X., Liu, Z., & Xu, Z. (2019). *A Decision Support System for Railway Freight Operations.* Procedia Computer Science, 147, 81-87. https://doi.org/10.1016/j.procs.2019.01.124 [in English].

7. Gomez, M. L., & Nunez, A. (2020). *A Framework for Risk Assessment in Railway Systems: Integrating Safety and Economic Performance.* Safety Science, 121, 67-75. https://doi.org/10.1016/j.ssci.2019.08.019 [in English].

8. Systemy i metody pidtrymky pryiniattia rishen [Elektronnyi resurs] : pidruchnyk dlia zdobuvachiv stupenia mahistra za spetsialnistiu 124 Systemnyi analiz / P. I. Bidiuk, O. L. Tymoshchuk, A. Ye. Kovalenko, L. O. Korshevniuk; KPI im. Ihoria Sikorskoho. Kyiv : KPI im. Ihoria Sikorskoho 2022. – 610 p. [in Ukrainian].

РОЗРОБЛЕННЯ ІНФОРМАЦІЙНОЇ ТЕХНОЛОГІЇ ПІДТРИМКИ ПРИЙНЯТТЯ РІШЕНЬ ДЛЯ СИСТЕМНОГО ТА СТРАТЕГІЧНОГО АНАЛІЗУ АТ «УКРЗАЛІЗНИЦЯ»

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Анотація. У статті запропоновано інформаційну технологію системи підтримки прийняття рішень для системного та стратегічного аналізу АТ «Укрзалізниця».

Метою дослідження є створення комплексної автоматизованої інформаційної системи, яка інтегрує сучасні методи якісного та кількісного аналізу даних для ефективного управління бізнес-процесами, оцінки ризиків і стратегічного планування в залізничній галузі.

Об'єктом дослідження є система підтримки прийняття рішень для системного та стратегічного аналізу в АТ «Укрзалізниця», яка включає методи аналізу даних, архітектуру, а також механізми інтеграції з іншими інформаційними системами компанії.

Авторами детально описано архітектуру та функціональність запропонованої системи підтримки прийняття рішень, яка включає три рівні: рівень даних (збір, обробка та зберігання інформації з різних внутрішніх та зовнішніх джерел), рівень аналізу (якісний та кількісний аналіз з використанням сучасних методів та інструментів) та рівень прийняття рішень (візуалізація даних, звітність та рекомендації). Крім того, описані групи методів для кожної підсистеми та програмні засоби і технології, які можуть бути використані для реалізації інформаційна технологія СППР.

Для вибору правильного рішення, згідно заданих критеріїв, використовуються сучасні аналітичні методи, включаючи штучний інтелект, машинне навчання та економетричні моделі, що дозволяють ефективно прогнозувати тенденції та оцінювати ризики.

Запропонована інформаційна технологія СППР сприятиме кращій інтеграції з іншими інформаційними системами компанії, забезпечуючи повний обмін даними та уникнення дублювання. Впровадження цієї системи дозволить підвищити конкурентоспроможність «Укрзалізниці» на національному та міжнародному рівнях.

Подальші дослідження передбачають розширення функціональних можливостей системи, зокрема через застосування технологій глибокого навчання та блокчейн для забезпечення прозорості та безпеки інформаційних процесів. Розвиток нових аналітичних методів також сприятиме підвищенню точності прогнозування та адаптивності стратегії.

Ключові слова: інформаційна технологія, система підтримки прийняття рішень, якісний та кількісний аналіз даних, стратегічний аналіз, машинне навчання.

Перелік посилань

1. Зінченко А. Ю. (2023). Проектування розподілених інформаційних систем на основі використання технології слабозв'язаних компонентів. *Системи та технології*, *63*(1), 5-14. https://doi.org/10.32782/2521-6643-2022.1-63.1

2. Zhang, Y., Yang, G., Jiang, H., & Wang, W. (2021). A Survey on Data-Driven Predictive Maintenance for the Railway Industry. *Sensors*, 21(17), 5739. https://doi.org/10.3390/s21175739

3. Smith, J., & Lee, B. (2020). An Improved Big Data Analytics Architecture Using Federated Learning for Transportation Systems. *Sustainability*, 15(21), 15333. https://doi.org/10.3390/su152115333

4. Srinivasan, P., & Shaw, J. (2021). *Optimization Methods for Railway System Planning: A Systematic Literature Review.* Transport Research Part C: Emerging Technologies, 122, 102877. https://doi.org/10.1016/j.trc.2020.102877.

5. Hsu, C.-H., & Liu, Y.-L. (2020). *Application of Artificial Intelligence in Railway System Decision Support.* Journal of Transportation Engineering, 146(7), 04020049. https://doi.org/10.1061/(ASCE)TE.1943-5436.0000731

6. Zhao, X., Liu, Z., & Xu, Z. (2019). *A Decision Support System for Railway Freight Operations.* Procedia Computer Science, 147, 81-87. https://doi.org/10.1016/j.procs.2019.01.124.

7. Gomez, M. L., & Nunez, A. (2020). *A Framework for Risk Assessment in Railway Systems: Integrating Safety and Economic Performance.* Safety Science, 121, 67-75. https://doi.org/10.1016/j.ssci.2019.08.019.

8. Системи і методи підтримки прийняття рішень [Електронний ресурс] : підручник для здобувачів ступеня магістра за спеціальністю 124 Системний аналіз / П. І. Бідюк, О. Л. Тимощук, А. Коваленко, Л. О. Коршевнюк ; КПІ ім. Ігоря Сікорського. Київ : КПІ ім. Ігоря Сікорського 2022. 610 с.

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