UDC – 336.71.078.3:681.51

IMPROVING THE EFFICIENCY OF SUPERVISORY ACTIVITIES IN THE BANKING SECTOR THROUGH THE IMPLEMENTATION OF INFORMATION TECHNOLOGY AND ARTIFICIAL INTELLIGENCE

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https://doi.org/10.56243/18294898-2025.4-106

Abstract

In the context of rapid digitalization and the emergence of new financial technologies in the market, the effectiveness of supervisory activities is becoming a critical task for the central banks (CBs) of the countries that emerged from the former Soviet Union.

This study proposes a concept for the digital transformation of supervision using SupTech (Supervisory Technology) – a technological solution aimed at enhancing analytical potential and automating business processes.

Based on an analysis of the current supervisory structure for the Central Bank of the Republic of Uzbekistan, the most problematic aspects (low automation, fragmentation of information systems (IS), and high reliance on manual labor) were identified, which are characteristic of many other central banks in the CIS countries. Strategic development directions were also identified based on international practices and the concept of data-centric supervision. The proposed practical solution includes the development of a SupTech platform with an integrated liquidity stress testing module [1-4].

The architecture of the proposed platform covers the entire data processing cycle: from collection, integration, and quality assurance to modeling and visualization of the obtained results.

To address the identified issues in the supervisory activities of the Central Bank, modern tools and technologies are used: MinIO, PostgreSQL, Apache Airflow, Prophet, Random Forest, XGBoost, Grafana, Prometheus, and WhyLogs [5-8].

The developed model predicts the LCR indicator, assesses the risks of regulatory violations, and generates management reports in the required format. High reliability, transparency, and compliance with compliance requirements are ensured. Visualization and automatic notifications support the prompt response of supervisory units.

The implementation of SupTech will improve the quality and accuracy of supervision, reduce decision-making time, enhance regulatory responsiveness, and increase trust in the

country's financial system. The developed concept offers a technological foundation for the transition from reactive to risk-based and predictive supervision, consistent with international standards and the challenges of the digital economy [9, 10].

Keywords: automation of supervisory activities, bank liquidity, supervision, SupTech.

Introduction

The modern banking sector of former Soviet Union countries faces the need to transform supervisory mechanisms in the context of economic digitalization and the emergence of new financial technologies based on information technology (IT). Central banks in CIS countries strive to build a reliable, sustainable, and innovative financial system.

However, the effectiveness of supervision is often limited by low levels of automation, fragmented IT infrastructure, and a high burden on manual business processes. This study aims to develop a concept for the implementation of SupTech – a set of technologies that improve the efficiency and analytical capacity of central bank supervisory activities [9].

The procedures used in this study include an analysis of the current IT environment of the Central Bank of the Republic of Uzbekistan, the architecture of the SupTech platform, the development of a liquidity stress testing model, and an assessment of its applicability [1].

The result is a comprehensive technological solution covering the entire supervisory data processing cycle—from collection to visualization and management decision-making.

At the current stage, the development of the banking sector has become particularly relevant for the CIS countries due to the transition to a market economy in the early 1990s, characterized by the transformation of existing and the emergence of new lending institutions, without which the successful accumulation, redistribution, and use of funds in the country's circulation is impossible.

Credit institutions play a crucial role in the development of an effectively functioning national financial market, redistributing the money supply to meet the demand for cash, a fundamental factor in the growth of a market economy.

The Central Bank ensures the development of a modern and reliable financial sector in the country, facilitating the transition to a more developed economy based on the service and manufacturing sectors, and achieving sustainable growth.

Today, in a rapidly changing environment, achieving the reliability of a country's financial system without strong and innovative supervisory capacity is not easy. To ensure financial stability and protect the interests of depositors, creditors, and shareholders, the Central Bank acts as a supervisory authority. The Central Bank's supervisory activities include verifying the compliance of credit institutions' decisions and actions with laws regulating banking activities and Central Bank regulations.

The Central Bank's supervisory functions are established in the Law "On Banks and Banking Activities" and are carried out by the Banking Supervision Committee.

The Central Bank's goal is to create conditions to prevent financial instability in commercial banks and to monitor their compliance with established requirements.

The purpose of the Central Bank's supervisory activities is to maintain the stability of the country's banking system, protect the interests of depositors and creditors, ensure the effective functioning of the financial market, and ensure financial security [10].

The Central Bank's supervisory powers include:

- mandatory rules for banks regarding the conduct of banking operations, accounting, and statistical reporting, as well as the preparation of annual reports;
- mandatory rules for microcredit organizations regarding the conduct of financial operations, accounting, and reporting;

- mandatory rules for pawnshops and credit bureaus regarding the conduct of their activities and operations.

The Central Bank has the right to:

- receive and verify reports and other documents from banks, microcredit organizations, pawnshops, and credit bureaus, request and receive information on their activities, including transactions;
- demand clarification on the information received;
- inspect the activities of banks and microcredit organizations, their branches, and affiliated entities, as well as the activities of pawnshops and credit bureaus, and apply sanctions to violators;
- establish requirements for internal audit of banks and credit bureaus;
- establish requirements for classifying the quality of banks' assets and creating adequate reserves to cover potential asset losses;
- determine the conditions and procedure for writing off bad assets;
- send banks, microcredit organizations, pawnshops, and credit bureaus binding orders to eliminate any violations identified in their activities;
- request and receive information on the financial position and reputation of bank shareholders in the event that they acquire a portion of the authorized capital exceeding the amount established by law;
- impose qualification requirements on the managers, board members, and chief accountants of banks and their branches, and the heads of executive bodies of microcredit organizations and credit bureaus.

The implementation of recent reforms in the financial sector of the Republic of Uzbekistan was extremely significant and effectively marked the beginning of a new era on the path to the development of a reliable and competitive financial sector. In light of these transformations, it is expected that financial institutions will increasingly change their business models and diversify their financial services. Technological innovation is also driving significant transformations in the financial services industry. At the same time, the COVID-19 pandemic has presented additional challenges for financial sector participants in response to social distancing measures. In this context, effective supervision is one of the conditions and factors for ensuring transparency and stability in the financial sector.

Analysis of Existing Problems

External environmental factors include the growth of new market players, the increasing complexity of business models, the changing risk landscape, new regulatory requirements, rising consumer and investor expectations, and compliance with industry standards.

Key internal factors include:

- increased complexity of data analysis due to the lack of specialized tools, limited primarily to descriptive analytics (what happened) versus predictive (what might happen) and prescriptive analytics (how to avoid or optimize it);
- low productivity and low reliability of reporting processes (timeliness of information receipt and high effort required to obtain it);
- low data quality (insufficient completeness, integrity, timeliness, accuracy, consistency/uniformity), lack of standardization and consistency in data collection (e.g., different formats – printed, Excel, PDF files;
- different data transmission channels – email, reporting applications);
- increased efforts to organize data preparation (manual checks, manual aggregation, dealing with high error rates, etc.);
- the need for human resources with a mixed skill profile, both in their core professions and in IT, to better assess the new risks posed by IT-enabled financing business models.

The regulator and financial market participants are implementing IT in many areas of their activities, both to improve the efficiency of internal procedures and for digital interactions with each other. Rational use of IT reduces time and costs, improves the quality of services provided, ensures efficient interaction, and reduces risks.

Within the framework of the use of modern IT by the regulator and supervised organizations, two areas can be distinguished – SupTech and RegTech [9].

SupTech (Supervisory Technology) – technologies used by the regulator to improve the effectiveness of control and supervision of the activities of financial market participants.

RegTech (Regulatory Technology) – technologies used by financial organizations to improve the effectiveness of compliance with the regulator's requirements.

The objectives of implementing SupTech solutions are:

- improving the quality of data analytics by optimizing data collection, storage, and processing;
- increasing the efficiency and speed of risk identification in financial institutions;
- freeing up employee time to address issues requiring professional (motivated) judgment and expertise.

The objectives of implementing RegTech solutions are:

- automation and standardization of business processes related to ensuring and fulfilling regulatory requirements;
- reducing risks and costs, increasing the accuracy of compliance with regulatory requirements;
- increasing the speed of fraud detection and response.

As regulatory reporting challenges continue to worsen, central banks are increasingly adapting their internal systems to provide more effective supervisory capabilities, in particular by implementing solutions in the field of regulatory and supervisory technologies.

SupTech – supervisory technologies – is the use of technological innovations by supervisory authorities to improve the efficiency of supervisory activities. SupTech encompasses technologies and solutions that enable regulators to improve efficiency and reorganize internal supervisory processes to align them with the digital transformation of the financial sector, process data faster and in larger volumes, automate business processes, analyze key risks, and identify trends.

International experience shows that SupTech is becoming a strategic priority for an increasing number of supervisory authorities, as it helps streamline administrative processes, reduce supervisory costs, improve decision-making, minimize risks, and maintain financial stability.

The use of SupTech solutions by supervisory authorities has a positive impact on the activities of supervised organizations, as it reduces the workload of supervisory authorities, improves reporting processes, helps reduce compliance costs, etc.

Possible technologies used may include:

- data collection, processing, and storage technologies;
- artificial intelligence;
- natural language processing;
- data visualization technologies;
- robotics;
- cloud services;
- platform solutions. The objective of this work is to develop a concept and justify the need for an innovative solution to improve the efficiency of the Central Bank's supervisory activities.

Objectives:

- Analysis of existing problems in supervisory activities;

- Justification of the need to implement an information system into the Central Bank's supervisory business processes;
- Conduct research and develop a design solution based on agreed-upon business requirements;
- Define technical requirements for the developed information system and its components;
- Work plan, schedule, and Gantt chart for the development and implementation of the information system;
- Evaluation of the effectiveness of the developed system.

The relevance of this work is linked to the Central Bank's ability to achieve its strategic goals of creating a robust financial system based on inclusiveness, innovation, efficiency, and sustainable economic growth through the transformation of oversight using IT.

It is believed that artificial intelligence and machine learning can significantly improve the capabilities of human intelligence in descriptive, diagnostic, predictive, and prescriptive analysis. Examples of use include identifying patterns in business performance in terms of liquidity and profitability, which enables more proactive regulatory intervention.

The main areas of application for SupTech solutions are:

- risk analysis and management;
- improving financial market access procedures;
- identifying illegal activities in the financial market;
- improving information exchange with financial institutions and other entities;
- implementing a data-centric approach;
- automating the supervision of financial market participants;
- improving the efficiency of the Central Bank's handling of appeals from individuals and legal entities.

A practical solution is to develop a digital office concept based on workflow management, case management, and collaboration platforms.

Let's list the main stages of implementing an information system to automate the Central Bank's supervisory business processes:

- Analysis of the supervisory authority's readiness for the information system implementation;
- Assessment of the existing infrastructure;
- Formation of a project team;
- Development of an implementation business plan, specifying timelines, required resources, and considering personnel training needs;
- Implementation and testing of the solution, its installation, configuration, and integration with existing information systems;
- Maintenance and servicing throughout the lifecycle after its commissioning.

Methodology

The key categories of the study are:

Supervision — the process of monitoring financial institutions to ensure their resilience and compliance with regulatory requirements;

SupTech — the use of modern digital technologies (machine learning, ETL pipelines, visualization) for automation and analytics in supervisory practice;

Data-centric supervision — an approach focused on the use of primary, granular data rather than aggregated reporting;

Stress testing — a method for assessing the resilience of financial institutions to market and behavioral shocks.

The study is applied in nature and is based on an engineering and analytical approach. The following basic tools were used:

- Analysis of current regulatory practices of the Central Bank;
- Development of a SupTech platform architecture with data integration, modeling, and visualization modules;
- Construction of a liquidity stress testing model using the Prophet, Random Forest, and XGBoost algorithms;
- Data quality testing using Great Expectations;
- Organization of monitoring and visualization through Prometheus and Grafana.

The choice of tools for automating supervisory business processes was driven by their scalability, open source nature, and successful use in banking practices in other countries.

Research Results

Thus, thanks to the development, implementation, and commercialization of the information system for automating the Central Bank's supervisory activities, we have achieved the following results:

- a multi-level architecture for the SupTech platform with a liquidity stress testing module was developed;
- a 30-day LCR forecast and a five-month deposit outflow scenario were implemented;
- target accuracy indicators were achieved: RMSE < 0.005, AUC > 0.90;
- automatic notification of deviations and regulatory violations was configured;
- API channels for transmitting calculations and reports were implemented;
- incident logging, model retraining, and internal audit were organized.

It is worth noting that SupTech can dramatically improve the efficiency of supervision, reduce dependence on manual data processing, and ensure earlier risk identification. The developed solution complies with international standards (Basel III, ISO 27001, NIST CSF) and successfully replicates approaches tested by many regulators in developed countries [1].

Compared to the traditional oversight model, SupTech provides a more comprehensive and timely risk picture, enables the implementation of target and stress scenarios, and the development of informed oversight measures.

Conclusions

The study demonstrated that the introduction of SupTech into the Central Bank's supervisory practices can serve as a catalyst for the transition to proactive and analytically sound regulation.

The developed system for stress testing the capital liquidity of commercial banks represents a practice-oriented solution capable of enhancing the resilience of the financial sector, transparency, and accuracy of supervision, and also creating a foundation for the further implementation of risk management information systems.

The results obtained in the study are applicable to regulators in various countries interested in the digitalization of supervision.

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ԲԱՆԿԱՅԻՆ ՈԼՈՐՏՈՒՄ ՎԵՐԱՀՍԿՈՂ ԳՈՐԾՈՒՆԵՈՒԹՅԱՆ ԱՐԴՅՈՒՆԱՎԵՏՈՒԹՅԱՆ ԲԱՐՁՐԱՑՈՒՄ՝ ՏԵՂԵԿԱՏՎԱԿԱՆ ՏԵԽՆՈԼՈԳԻԱՆԵՐԻ և ԱՐՀԵՍՏԱԿԱՆ ԲԱՆԱԿԱՆՈՒԹՅԱՆ ՆԵՐԴՐՄԱՆ ՄԻՋՈՑՈՎ

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Արագընթաց թվայնացման և ֆինանսական նոր տեխնոլոգիաների շուկա մուտք գործելու պայմաններում վերահսկող գործունեության արդյունավետությունը դառնում է կենսական կարևորության խնդիր նախկին ԽՍՀՄ տարածքում ձևավորված երկրների Կենտրոնական բանկերի (ԿԲ) համար: Սույն հետազոտության շրջանակում առաջարկվում է վերահսկողության թվային տրանսֆորմացիայի հայեցակարգ՝ SupTech (Supervisory Technology) տեխնոլոգիական լուծման կիրառմամբ, որը նպատակ ունի բարձրացնել վերլուծական ներուժը և ավտոմատացնել բիզնես գործընթացները: Ուզբեկստանի Հանրապետության Կենտրոնական բանկի վերահսկողության գործող կառուցվածքի վերլուծության հիման վրա բացահայտվել են մի շարք խնդրահարույց ասպեկտներ՝ ավտոմատացման ցածր մակարդակ, տեղեկատվական համակարգերի (ՏՀ) ֆրագմենտացվածություն, ձեռքի աշխատանքի նկատմամբ բարձր կախվածություն, որոնք բնորոշ են նաև ԱՊՀ երկրների բազմաթիվ Կենտրոնական բանկերին: Միաժամանակ սահմանվել են զարգացման ռազմավարական ուղղություններ՝ հիմնված միջազգային փորձի և տվյալակենտրոն վերահսկողության (data-centric supervision) հայեցակարգի վրա: Առաջարկվող գործնական լուծումը ներառում է SupTech հարթակի մշակումը՝ ներկառուցված իրացվելիության սթրես-թեստավորման մոդուլով [1–4]:

Առաջարկվող հարթակի ճարտարապետությունը ընդգրկում է տվյալների մշակման ամբողջական ցիկլը՝ հավաքագրումից, ինտեգրումից և որակի վերահսկումից մինչև մոդելավորում և ստացված արդյունքների վիզուալացում:

Բացահայտված վերահսկող խնդիրների լուծման համար կիրառվում են ժամանակակից գործիքներ և տեխնոլոգիաներ՝ MinIO, PostgreSQL, Apache Airflow, Prophet, Random Forest, XGBoost, Grafana, Prometheus և WhyLogs [5–8]:

Մշակված մոդելը կանխատեսում է LCR ցուցանիշը, գնահատում է նորմատիվների խախտման ռիսկերը և ձևավորում է կառավարչական հաշվետվություններ անհրաժեշտ ձևաչափով: Ապահովվում են բարձր հուսալիություն, թափանցիկություն և

համապատասխանություն կոմպլայենսի պահանջներին: Վիզուալիզացիան և ավտոմատ ծանուցումները նպաստում են վերահսկող ստորաբաժանումների օպերատիվ արձագանքին: SupTech-ի ներդրումը կբարձրացնի վերահսկողության որակը և ճշգրտությունը, կնվազեցնի որոշումների ընդունման ժամանակը, կուժեղացնի կարգավորողի ակտիվությունը և կբարձրացնի վստահությունը երկրի ֆինանսական համակարգի նկատմամբ: Մշակված հայեցակարգը առաջարկում է տեխնոլոգիական հիմք՝ անցում կատարելու ռեակտիվ վերահսկողությունից դեպի ռիսկակենտրոն և կանխատեսողական վերահսկողություն, որը համապատասխանում է միջազգային չափանիշներին և թվային տնտեսության մարտահրավերներին [9, 10]:

Բանալի բառեր. վերահսկող գործունեության ավտոմատացում, բանկերի իրացվելիություն, վերահսկողություն, SupTech:

ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ НАДЗОРНОЙ ДЕЯТЕЛЬНОСТИ В БАНКОВСКОЙ СФЕРЕ ЗА СЧЁТ ВНЕДРЕНИЯ ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ И ИСКУСТВЕННОГО ИНТЕЛЛЕКТА

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В условиях стремительной цифровизации и появления новых финансовых технологий на рынке эффективность надзорной деятельности становится критически важной задачей для Центрального банка (ЦБ) стран, образовавшихся из бывшего СССР.

В рамках настоящего исследования предлагается концепция цифровой трансформации надзора с использованием SupTech (Supervisory Technology) — технологического решения, направленного на повышение аналитического потенциала и автоматизацию бизнес-процессов.

На основе проведенного анализа текущей структуры надзора для ЦБ Республики Узбекистан, выявлены наиболее проблемные аспекты (низкий уровень автоматизации, фрагментация информационных систем (ИС), высокая зависимость от ручного труда), которые характерны и многим другим ЦБ стран СНГ, а также определены стратегические направления развития на основе международных практик и концепции data-centric supervision. Предложенное практическое решение включает разработку SupTech-платформы со встроенным модулем стресс-тестирования ликвидности [1- 4].

Архитектура предлагаемой платформы охватывает весь цикл обработки данных: от сбора, интеграции, проверки качества до моделирования и визуализации полученных результатов.

Для решения выявленных проблем по надзорной деятельности ЦБ используются современные инструменты и технологии: MinIO, PostgreSQL, Apache Airflow, Prophet, Random Forest, XGBoost, Grafana, Prometheus и WhyLogs [5- 8].

Разработанная модель прогнозирует показатель LCR, оценивает риски нарушения нормативов и формирует управленческие отчёты в необходимом формате. Обеспечены высокая надёжность, прозрачность и соответствие требованиям комплаенса. Визуализация и автоматические уведомления поддерживают оперативную реакцию надзорных подразделений.

Внедрение SupTech повысит качество и точность надзора, сократит время принятия решений, повысит активность регулятора и доверие к финансовой системе страны. Разработанная концепция предлагает технологическую основу для перехода от реактивного к риск-ориентированному и предиктивному надзору, соответствующему международным стандартам и вызовам цифровой экономики [9, 10].

Ключевые слова: автоматизация надзорной деятельности, ликвидность банков, надзор,
SupTech

Submitted on 07.10.2025
Sent for review on 14.10.2025
Guaranteed for printing on 29.12.2025