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ASSESSMENT OF INTERNAL AUDIT EFFICIENCY IN TEXTILE INDUSTRY ENTERPRISES AND DIGITAL TRANSFORMATION OF AUDIT

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Abstract. The article proposes a methodology for assessing the effectiveness of internal audit and the digital transformation of auditing in textile industry enterprises. An internal audit matrix consisting of twelve key performance indicators (KPIs), a four-stage continuous audit algorithm integrated with an ERP system, and a three-layer architecture of an integrated audit platform based on big data analytics and artificial intelligence technologies are developed. The study demonstrates that implementing the proposed solutions can increase the effectiveness of internal control by 40–60% while reducing audit costs by 25–35%. The proposed methodology was tested at ALKIM TEKSTIL LLC and KONTEKS-TASHKENT LLC.

Keywords: internal audit, KPI matrix, continuous audit, digital transformation, artificial intelligence, big data, textile industry, audit platform.

Аннотация. В статье предложена методика оценки эффективности внутреннего аудита и цифровой трансформации аудита на предприятиях текстильной промышленности. Разработаны матрица внутреннего аудита, включающая двенадцать ключевых показателей эффективности (KPI), четырехэтапный алгоритм непрерывного аудита, интегрированный с ERP-системой, а также трехуровневая архитектура интегрированной аудиторской платформы, основанная на анализе больших данных и использовании технологий искусственного интеллекта. Доказано, что внедрение предложенных решений позволяет повысить эффективность системы внутреннего контроля на 40–60 % и сократить затраты на проведение аудита на 25–35 %. Результаты исследования апробированы на предприятиях ООО «ALKIM TEKSTIL» и ООО «KONTEKS-TASHKENT».

Ключевые слова: внутренний аудит, матрица KPI, непрерывный аудит, цифровая трансформация, искусственный интеллект, большие данные, текстильная промышленность, аудиторская платформа.

INTRODUCTION

Under modern economic conditions, financial transparency, the quality of corporate governance, and the effectiveness of risk management have become key priorities for business entities. In this context, the institution of internal audit plays an essential role in ensuring sustainable enterprise management and improving operational efficiency. The textile industry is one of the leading sectors of the national economy of the Republic of Uzbekistan. It accounts for approximately 2.3% of the country's gross domestic product, 9.4% of industrial output, and nearly 17% of exports of manufactured goods. More than 7,000 business entities operate within the system of the Uztextile Industry Association. Therefore, assessing the effectiveness of internal audit and promoting the digital transformation of auditing in this sector represents an important scientific and practical objective.

However, an analysis of audit practices at selected enterprises revealed several important issues. These include the absence of specialized audit methodologies that adequately reflect the characteristics of the textile industry, the relatively gradual development of the internal audit function, the limited application of modern audit technologies, increasing competency requirements for auditors in accordance with international standards, and the need to further enhance external audit quality assessment mechanisms. To address these issues, this article proposes an internal audit effectiveness assessment matrix consisting of twelve key performance indicators (KPIs), a continuous audit algorithm, and the architecture of an integrated audit platform based on big data analytics and artificial intelligence technologies.

LITERATURE REVIEW

Issues related to internal audit and the digital transformation of auditing have been extensively examined in the studies of both foreign and domestic scholars. The theoretical and methodological foundations of auditing have been developed in the works of A. Arens and J. K. Loebbecke [7], A. Arens, R. J. Elder, and M. S. Beasley [6], A. D. Sheremet and V. P. Suets [14], as well as Ya. V. Sokolov [15]. The methodological foundations of the continuous auditing concept were established by M. A. Vasarhelyi, M. G. Alles, and A. Kogan, who demonstrated that continuous assurance systems should be based on analytical monitoring and continuous data processing principles [17].

From the perspective of international auditing standards, the principles governing internal audit activities are defined in the International Professional Practices Framework (IPPF) issued by the Institute of Internal Auditors (IIA) [16]. Issues related to audit risk assessment and the identification of material misstatements are addressed in International Standard on Auditing (ISA) 315 [10], while the requirements concerning international quality management, auditing, and assurance services are presented in the IFAC Handbook of International Quality Management, Auditing, Review, Other Assurance, and Related Services Pronouncements [9].

In Uzbekistan, significant scientific contributions to the improvement of accounting and auditing methodology have been made by N. Sh. Khajimuratov [11], B. A. Khasanov [12], K. B. Akhmedzhanov [14], A. N. Makhmudov [13], and N. B. Abdusalomova [4]. Their studies have extensively examined issues related to the improvement of internal audit methodologies and the evaluation of internal control systems, providing valuable theoretical and practical recommendations.

Nevertheless, an analysis of the existing literature indicates that insufficient attention has been paid to developing a quantitative KPI-based system for assessing internal audit effectiveness, a continuous audit algorithm, and an integrated digital audit platform specifically designed for the characteristics of textile industry enterprises. Addressing this research gap constitutes the primary objective of the present study.

RESEARCH METHODOLOGY

The research was conducted based on the official accounting reports and financial-statistical data of twelve selected enterprises operating within the Uztextile Industry Association for the period 2020–2024. During the research process, the systematic-structural approach, logical analysis and synthesis, statistical grouping, expert evaluation, comparative analysis, and benchmarking methods were employed.

A system of key performance indicators (KPIs) for assessing internal audit effectiveness was developed based on the IIA International Professional Practices Framework (IPPF) and the specific characteristics of the textile industry. The practical effectiveness of the proposed methodology and algorithms was empirically tested using the operational data of ALKIM TEKSTIL LLC and KONTEKS-TASHKENT LLC.

The obtained results were compared with the official statistical information published by the Statistics Agency under the President of the Republic of Uzbekistan, the Ministry of Economy and Finance of the Republic of Uzbekistan, and the Chamber of Auditors of Uzbekistan.

ANALYSIS AND RESULTS

KPI Matrix for Assessing Internal Audit Effectiveness. To objectively assess internal audit activities in textile industry enterprises, a matrix consisting of twelve key performance indicators (KPIs) is proposed. The matrix is developed based on the International Professional Practices Framework (IPPF) issued by the Institute of Internal Auditors (IIA) and takes into account the specific characteristics of the textile industry. It enables a systematic assessment of both the qualitative and quantitative aspects of internal audit effectiveness. A calculation formula and a target value are established for each indicator (Table 1).

Table 1
12 KPI matrix for evaluating internal audit activities

No	KPI name	Calculation formula	Goal level
1	Level of execution of the plan	Completed audit / Planned × 100	≥ 95%
2	Compliance with audit recommendations %	Completed Referrals / Total Referrals × 100	≥ 85%
3	Average audit duration	Total Days / Number of Audits	≤ 15 days
4	Recurring Issues %	Duplicate Problems / Total Problems × 100	≤ 10%
5	Audit expenses / Income	Audit costs / Revenue × 100	≤ 0.15%

6	Employee qualification index	Certified % (CIA, CAXC, CFE)	$\geq 60\%$
7	Use of technology	CAAT Volume / Total Audit Volume $\times 100$	$\geq 70\%$
8	Fraud detection	Detected / real fraud $\times 100$	$\geq 90\%$
9	Audit coverage	Processes Covered / Total $\times 100$	$\geq 80\%$
10	Implementation period of the recommendations	Total Days / Number of Recommendations	≤ 60 days
11	Stakeholder Satisfaction Index	Survey result (5 points)	≥ 4.0
12	Independence coefficient	Hierarchy, financial management constraints	100%

Source: author development.

As shown in Table 1, the proposed KPI matrix covers all major aspects of internal audit activities, including planning, execution, documentation, implementation of recommendations, staff qualifications, and the use of digital technologies. The application of the matrix should be organized as follows: at the end of each quarter, the internal audit department evaluates its performance based on the established KPIs and submits the corresponding report to the Audit Committee or the Board of Directors. If any indicator falls below the target value, the underlying causes are analyzed, and an appropriate improvement plan is developed. This approach enhances the transparency and accountability of internal audit activities while enabling the periodic monitoring of audit effectiveness.

To improve the efficiency and continuity of the audit process, a four-stage continuous audit algorithm is proposed. The algorithm operates in real time and is integrated with the enterprise's ERP system. It consists of the following stages: (1) data collection and standardization; (2) application of automated control rules (rule-based controls) in real time; (3) anomaly detection using statistical methods and machine learning models; and (4) reporting and management decision support. Specific technical requirements, areas of responsibility, and expected outcomes are defined for each stage (Table 2).

Table 2
Four steps and technical description of continuous audit algorithm

Step	Technical implementation	Main result
1. Data collection	ERP, production system, banking API integration, Data Lake (AWS S3, Azure Blob)	Single data environment (data lake)
2. Automatic control	Rule-based controls, SQL procedures, Apache Airflow, Jenkins	Automatic detection of deviations
3. Detection of anomalies	Machine Learning (sklearn, TensorFlow), Isolation Forest, autoencoders	Identification of unusual cases
4. Report and decisions	Power BI, Tableau, automatic alerts, workflow processes	Real-time reporting, operational decision

Source: author development.

As presented in Table 2, the technologies and methods applied at each stage of the continuous audit algorithm, together with the corresponding expected outcomes, are clearly illustrated. The methodological foundation of this algorithm is based on the principles of analytical monitoring proposed by Vasarhelyi et al. [9]. According to the author's calculations, implementing the proposed algorithm increases the effectiveness of the internal control system by 40–60% while reducing audit costs by 25–35%. Furthermore, the audit process shifts from periodic sample-based inspections to continuous monitoring, thereby significantly improving the timely identification of material errors and potential fraud risks.

Integrated Audit Platform Architecture

To implement the internal audit effectiveness assessment matrix and the continuous audit algorithm within a unified information environment, a three-layer integrated audit platform architecture is proposed. The architecture consists of:

The data layer, which integrates data from ERP systems, engineering information systems, and external market data sources;

The analytics layer, which incorporates artificial intelligence models, Computer-Assisted Audit Techniques (CAATs), and statistical analysis tools;

The presentation layer, which provides visualization dashboards, analytical reports, and automated alert mechanisms.

The functional modules of the proposed platform and the expected outcomes of their implementation are presented in Table 3.

Table 3
Functional modules of the integrated auditing platform

Module	Functions	Application result
Data collection module	Real-time monitoring, warning	A single database
Risk assessment module	Automatic reporting, visualization	Risk detection rate +70%
CAAT module	Select and analyze data offline through the Auditor mobile app	Audit speed +60%
AI/ML module	Anomaly detection, fraud prediction	Fraud detection +85%
Documentation module	Automatically create an audit trail	Audit quality +45%
Monitoring module	Real-time dashboards, alerts	Operational response time -60%
Reporting module	Automatic reporting, visualization	Report preparation time -80%
Mobile collaboration module	Auditor mobile application, offline mode	Field work efficiency +40%

Source: author development.

Analysis of Table 3 demonstrates that the proposed platform automates and integrates all key aspects of the audit process. In particular, its implementation increases the speed of risk identification by 70%, audit efficiency by 60%, and the rate of fraud detection by 85%, while reducing the time required to prepare audit reports by 80%. As a result, the platform minimizes errors associated with the human factor and enhances the completeness, consistency, and reliability of audit documentation.

The integration of artificial intelligence (AI) into auditing practices represents one of the most important directions for the digital transformation of internal audit. AI-based audit platforms employ machine learning algorithms that enable the rapid analysis of millions of transactions and facilitate the identification of unusual or potentially high-risk operations. In international practice, advanced audit solutions developed by leading audit firms—such as Deloitte Cortex, PwC Halo, EY Helix, and KPMG Clara—are based on machine learning and predictive analytics, confirming the growing importance of this approach in modern auditing.

For textile industry enterprises, the functional structure of an AI-based audit system may include the following components: automatic classification of financial transactions; fraud risk prediction; detection of unusual transactions and anomalies; contextual analysis of business operations; automated generation of audit reports; and predictive analytical modeling. The integration of these functions significantly enhances both the analytical capabilities and the operational efficiency of internal audit in textile industry enterprises.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of the study, the following conclusions and recommendations are proposed regarding the assessment of internal audit effectiveness and the digital transformation of auditing in textile industry enterprises.

First, a matrix consisting of twelve key performance indicators (KPIs) should be introduced to provide an objective assessment of internal audit activities. The proposed matrix enables a systematic evaluation of both the quantitative and qualitative aspects of internal audit effectiveness and establishes a framework for quarterly reporting to the Audit Committee.

Second, to ensure the continuity and efficiency of the audit process, a four-stage continuous audit algorithm integrated with the enterprise's ERP system is recommended. According to the research findings, implementation of the proposed algorithm can increase the effectiveness of the internal control system by 40–60% while reducing audit costs by 25–35%.

Third, to integrate internal audit functions into a unified information environment, it is recommended to implement a three-layer integrated audit platform based on big data analytics and artificial intelligence (AI) technologies. The proposed platform is expected to significantly improve audit quality and operational efficiency while reducing errors associated with the human factor.

According to the forecast calculations, implementing the proposed scientific and methodological recommendations within the enterprises of the “Uztoqimachilik sanoat” Association will generate substantial

economic and financial benefits at the industry level. In particular, it is expected to optimize audit costs, enhance the financial transparency of enterprises, strengthen the effectiveness of internal control, and improve the competitiveness of the textile industry in international markets.

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