

AUDIT OF THE EFFECTIVENESS OF SME SUPPORT IN THE CONTEXT OF THE DIGITAL TRANSFORMATION OF HUMAN RESOURCES OF THE SUPREME AUDIT INSTITUTION

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Abstract. This article aims to analyze the practical application of artificial intelligence (AI) technologies as a transformative factor for the human resource potential of the Supreme Audit Institution (SAI). The study focuses on the audit of the effectiveness of state support within the small and medium-sized enterprise (SME) sector of the Republic of Kazakhstan. The integration of AI algorithms into SAI activities fundamentally redefines the role of the state auditor, transforming them into a data analyst capable of identifying latent correlations between state support volumes and the qualitative growth of the enterprise sector. The study reveals a critical discrepancy: while there is a formal increase in the number of SMEs, current financial incentives in low-tech sectors remain largely ineffective. The findings suggest that the traditional audit system, lacking advanced data analytics, merely records budget absorption indicators without evaluating their impact on the technological complexity and productivity of the businesses involved. The originality of this research lies in the conceptualization of a fundamentally new model of state audit, in which AI serves as the primary driver of transforming SAI human capital. The practical significance is underscored by the development of algorithmic tools for "smart" monitoring of state support, integrated with national databases. The study justifies a methodology for detecting hidden inefficiency risks by automatically benchmarking allocated funds against SMEs' actual contribution to the country's economic development.

Keywords: artificial intelligence, small and medium-sized enterprises, supreme audit institution (SAI), human resources

Introduction

Professional literature is increasingly discussing the phenomenon of 'digital human capital' as a specific resource for audit organisations. This refers to the auditor's ability to move beyond the traditional role of 'bookkeeper'. The use of digitalisation enables them to become strategic analysts for the formulation of recommendations.

The issue of digital transformation is particularly relevant to the activities of Supreme Audit Institutions. Research shows that the external environment of these institutions is changing rapidly. Demands for transparency from the public, parliaments, and international bodies are constantly growing. At the same time, the entities being audited themselves — from ministries to small departments — are already actively implementing digital accounting. In such a situation, auditing simply cannot afford to remain 'analog'.

However, in practice, a dangerous trend is evident: the public sector is lagging catastrophically behind the private sector. Research data confirms the existence of a significant gap. There is an understanding that technology is important, but concrete steps towards digitalisation (particularly at the SME level) are woefully few. The study focuses on bridging the research gap between two areas. On the one hand, the digital transformation of the Supreme Audit Institution.

On the other hand, the effectiveness of SME support programs. The proposed approach is based on a comprehensive evaluation methodology. The key feature of the system lies in analysing the digital maturity of the audit institution. This synthesis allows actual-state support outcomes to be correlated with the level of control technology. In practice, supreme audit institutions often substitute genuine digital transformation with mere automation.

The process boils down to digitising outdated regulations. A significant proportion of state auditors fail to distinguish between piecemeal software implementation and a fundamental overhaul of approaches. This concerns a fundamental difference in decision-making and methods of interaction with audited entities. Without an understanding of this distinction, the transformation remains merely formal. The problem is exacerbated by the reactive nature of most regulatory bodies' work. Analysis of current practice confirms that technologies are implemented on a 'firefighting' basis. Often, this only happens when data volumes become physically unmanageable to process manually.

The foundation of the current work — the digital background of the VOA inspectors — determines the final quality of the audit. We proceed on the basis that competencies are the key determinant in this case. The

practice of implementing CAATs (computer-assisted audit techniques) in government bodies clearly suggests that a technology stack alone, detached from reality, does not produce the desired effect. Other variables are critically important here, such as organisational flexibility, the genuine (rather than merely formal) interest of top management, and the extent to which new solutions are seamlessly integrated into working ecosystems.

Today, we are seeing an explosive growth in interest in continuous auditing formats. This study is based on the premise that the quality of the Supreme Audit Institution's oversight performance regarding support programs for small and medium-sized enterprises is directly determined by the level of digital maturity of its human resources.

At a time when small businesses themselves are undergoing a complex process of digital adaptation, facing high technology costs, a skills shortage, and organisational resistance to change, the quality of external oversight becomes a critical factor determining the effectiveness of government investment in business support. The development of human resources requires systematic efforts: revising educational programs, establishing internal systems for continuous learning, and overcoming the conservatism of experienced staff accustomed to working with tried-and-tested tools. The aim of the study is to develop and empirically verify a methodology for assessing the effectiveness of state support for small and medium-sized enterprises, taking into account the level of digital maturity of the Supreme Audit Institution's human resources.

The results of the study are intended to contribute to the development of a theoretical understanding of the determinants of public audit effectiveness in the digital age and to offer practical recommendations for improving audit institutions' human resources policies. Thus, it is necessary to understand how SAIs interpret and approach CT, and to examine its implications for the future of public sector auditing in light of auditors' and experts' accumulated experience. At a more detailed level, the aims and objectives have been broken down into the following research questions:

- RQ1: What does CT mean from the perspective of the Supreme Audit Institution?
- RQ2: What is the experience of the Supreme Audit Institution, and how do they interpret or respond to the pressure associated with CT?

It is important to clarify that the present study is positioned as a pilot (exploratory) investigation – the first phase of a larger research project aimed at developing and validating a methodology for assessing the effectiveness of SME support in the context of digital transformation of SAI human resources.

Literature review

New public management has increased the demand for auditing in the public sector (Hyndman, Lapsley, 2016). The 2008 crisis and its aftermath demonstrated the need for greater transparency in public spending and more efficient use of funds (Lonsdale, 2011). Accountability requirements are increasing (Glynn, Murphy, 1996). According to a number of researchers, these depend on citizens, parliament, the media, donors, and the international community (Brignall, Modell, 2000). Supreme Audit Institutions (SAIs) face daily pressure and stakeholders' expectations. Changes have occurred due to parliamentary interest in audit results (Skene, 1985; Guthrie, Parker, 1999). Society has also demanded greater transparency (Kells, 2011; Morin, 2008; Tillema, Ter Bogt, 2010). SAIs must develop their audit activities to meet society's demands. Today, SAIs devote far more resources to auditing than was anticipated decades ago (Pollitt, 2003). The external environment of SAIs is changing, altering the demands and expectations of stakeholders (Hay, 2019). Regardless of their institutional structure, SAI type or the nature of the audit conducted, digitalisation is recognised as an important part of the future of auditing today (Lombardi et al., 2015; Hay, 2019).

Changes in the public sector present new challenges for SAIs and require the acquisition of new competencies and roles (Torres, Pina, 1999). SAIs are increasingly adopting and utilising new technologies, such as big data analytics, artificial intelligence, machine learning and blockchain. Research in the field of auditing is primarily devoted to the implementation/adoption and use of technologies, without, in principle, touching upon the concept of digital transformation (DT) at all (Manita et al., 2020; Warren et al., 2015). Nevertheless, there is as yet relatively little literature on how SAIs approach CT and utilise technology during audits. The bulk of research on CT and related concepts focuses on private-sector audits, particularly on the impact, adoption, or use of new technologies (Zhang et al., 2015). There is a marked lack of work on digital transformation in public sector auditing, whilst this topic is becoming increasingly prominent in professional journals and periodicals of SAIs at both the local and supranational levels (e.g., ECA Journal, INTOSAI Journal).

This study focuses on developing a methodology for assessing the effectiveness of state support for small and medium-sized enterprises (SMEs) in the context of the digital transformation of human resources within

the Supreme Audit Institution (SAI). The theoretical foundation of the study is the integration of three conceptual approaches: the 'Technology-Organisation-Environment' model (Tornatzky, Fleischer, 1990), the resource-based view (Barney, 1991) and human capital theory (Becker, 1964).

H 1: The level of digital human capital within the regulatory authority is positively correlated with the effectiveness of SME support programs, with this relationship being mediated by the quality of audits and the extent to which specialised computer-assisted audit tools are utilised.

This hypothesis is based on the assumption that the digital competencies of the supervisory body's staff do not directly affect enterprise activities but are realized through the quality of the audits conducted. The higher the auditors' proficiency with modern data analysis tools, the more in-depth and relevant their recommendations become, ultimately enhancing the effectiveness of adjustments to support programs. Thus, audit quality acts as a mechanism for transforming the SBA's human capital into tangible improvements for business.

H 2: The introduction of continuous and remote audit technologies into the SBA's activities enhances the positive impact of digital human capital on the effectiveness of SME support by increasing monitoring responsiveness and reducing administrative burdens on businesses.

The second hypothesis builds on the first by adding the technological aspect of the control activities themselves. It is assumed that the use of modern audit formats (continuous monitoring, remote data access) creates a synergistic effect: employees' digital competencies yield greater returns when implemented in a flexible, technology-driven environment. Furthermore, the transition to remote forms of interaction reduces the costs businesses incur for reporting and inspections, thereby enhancing the effectiveness of support.

Research methods and conditions

The dependent variable in the study is the EIT composite indicator of SME support effectiveness, which aggregates three key dimensions: the technological potential of beneficiary enterprises, their operational efficiency, and the sustainability of the results achieved. For the i -th enterprise in period t , the indicator is calculated using the following formula:

$$E_{it} = w_1 * \frac{TP_{it} - TP_{i0}}{TP_{i0}} + w_2 * \frac{LP_{it} - LP_{i0}}{LP_{i0}} + w_3 * \frac{DS_{it} - DS_{i0}}{DS_{i0}}$$

where:

TP_{it} — the technological capacity of the i -th business entity during period t (a composite index encompassing the presence of digital accounting systems, process automation, and the use of cloud technologies);

LP_{it} — labour productivity (revenue divided by the average number of employees);

DS_{it} — digital sustainability index (the duration of use of implemented digital solutions without any deterioration in functionality);

TP_{i0} , LP_{i0} , DS_{i0} — the values of the relevant indicators in the base period (prior to receiving support);

w_1 , w_2 , w_3 — weighting factors determined using an expert-based method, provided that $w_1 + w_2 + w_3 = 1$.

The VOA's digital human capital is operationalised through three components: auditor competencies, structural support, and organisational culture. The integrated index (HVOA) is calculated as follows:

$$HVOA = \alpha C + \beta S + \gamma K$$

where:

αC — digital Competence Index (average score of employees based on test results regarding their proficiency in using computer-based audit tools, understanding of big data, and cyber hygiene);

βS — structural adequacy index (availability of specialist posts, proportion of the budget allocated to teaching, software provision);

γK — organisational culture index (readiness for change, frequency of use of remote audit methods);

In accordance with the proposed hypotheses, two moderating variables are included in the model:

Audit quality (Q_{audit}) — measured by the extent to which computer tools are utilised, the timeliness of identifying non-compliance, and the proportion of recommendations implemented. This variable reflects the mediating mechanism through which digital human capital influences the effectiveness of support (H1).

Intensity of use of continuous and remote audit technologies (Tcont) — measured by the proportion of audits conducted using remote access, the frequency of real-time monitoring, and the presence of automated control systems. This variable reflects the amplifying effect of modern audit technologies (H2).

The model includes the following control variables at the firm level: size (S), industry affiliation (I), firm age (Age), as well as characteristics of the support programme: funding volume (F), duration of participation (D), and the presence of a consultancy component (C). The study is conducted using a sequential mixed-methods design, where the qualitative phase (interviews, document analysis) precedes the quantitative phase (questionnaire survey, statistical data analysis) and serves to refine the methodology, validate the variables, and interpret the results. In the first stage, semi-structured interviews are conducted with three categories of respondents: heads and key staff of SAO departments responsible for performance auditing (n = 12–15); representatives of relevant ministries and agencies implementing SME support programmes (n = 8–10); experts from professional accounting associations and the academic community (n = 8–10). Respondents are selected using an expert sampling method, followed by the ‘snowball’ technique. Each interview lasts 60–90 minutes. All interviews are recorded with the respondents’ consent and transcribed verbatim.

In the second stage, a questionnaire survey is being conducted. The total population comprises two groups of respondents: SAI staff involved in performance audits (N₁ = 420) and SME managers who are recipients of state support in the field of digitalisation (N₂ = 2,150). The sample size is calculated using the formula for the target population with a 95% confidence level and a 5% margin of error:

$$N = N \cdot z^2 \cdot p \cdot (1-p) / (N-1) \cdot \epsilon^2 + z^2 \cdot p \cdot (1-p)$$

where $z = 1.96$ (critical value of the standard normal distribution), $p = 0.5$ (expected proportion of the characteristic for maximum variation), and $\epsilon = 0.05$ (marginal sampling error). The calculation yields a minimum sample size of 10 respondents from the Internal Audit Department and 10 respondents from SMEs.

The sample is formed using a stratified, proportional allocation method. For VOA staff, stratification is based on unit type (performance audit departments, IT units, methodology departments). For SMEs, stratification is based on sector and company size.

The questionnaire is developed based on validated scales used in the studies by Lois et al. (2020), Hakami (2025), and Alshira'h and Alshirah (2025), and is adapted to the context of this study. The questionnaire for SAI staff includes sections on self-assessment of digital competencies (15 items, 1–5 Likert scale), frequency of use of specialised audit tools (10 items), perception of organisational support (8 items), and the use of continuous and remote audit technologies (6 items). The questionnaire for SME managers includes questions on the characteristics of the support received, the level of digitalisation of the enterprise, satisfaction with interaction with regulatory authorities, and the perceived administrative burden.

To test hypothesis H1 regarding the influence of the digital human capital of the SAI on the effectiveness of support for SMEs, mediated by the quality of audit engagements, the following specification of a fixed-effects regression model is used:

$$E_{it} = \beta_0 + \beta_1 H_{VOA,t-1} + \beta_2 Q_{audit,t-1} + \beta_3 (H_{VOA,t-1} \times Q_{audit,t-1}) + \beta_4 X_{it} + \delta_i + \tau_t + \epsilon_{it}$$

where: E_{it} — the effectiveness of support for the i -th enterprise during period t ;

$H_{VOA,t-1}$ — the level of digital human capital in the previous period (to account for the time lag in the impact);

$Q_{audit,t-1}$ — the quality of audits of support programs in the previous period;

$H_{VOA,t-1} \times Q_{audit,t-1}$ — an interactive term reflecting the mediating effect of audit quality;

X_{it} — vector of control variables;

δ_i — firm-specific fixed effects;

τ_t — temporary fixed effects;

ϵ_{it} — a random error.

To test hypothesis H2 regarding the amplifying effect of continuous and remote auditing technologies, a model with a triple interactive term is used:

$$E_{it} = \beta_0 + \beta_1 H_{VOA,t-1} + \beta_2 T_{cont,t-1} + \beta_3 (H_{VOA,t-1} \times T_{cont,t-1}) + \beta_4 X_{it} + \delta_i + \tau_t + \epsilon_{it}$$

where: $T_{cont,t-1}$ — the extent to which continuous and remote auditing technologies were utilised in the preceding period.

A positive and significant beta coefficient will indicate that modern auditing technologies enhance the return on the digital human capital of the audit organisation. Additionally, the following model is used to assess the impact of continuous audit technologies on reducing the administrative burden on businesses:

$$\text{Burdit} = \gamma_0 + \gamma_1 T_{\text{cont},t-1} + \gamma_2 Z_{it} + \delta_i + \tau_t + \text{vit}$$

where:

Burdit - is the perceived administrative burden on the i-th enterprise in period t, and Z_{it} is a vector of control variables.

For each latent construct, a measurement model with corresponding indicators is specified. The quality of the measurement models is assessed using reliability indicators (Cronbach's alpha, composite reliability), convergent validity (average variance extracted, $AVE \geq 0.5$), and discriminant validity (Fornell–Larker criterion). The internal consistency of the measurement scales is assessed using Cronbach's alpha:

$$\alpha = k * \bar{r} / 1 + (k-1) * \bar{r}$$

where: $\bar{r}$ — the average correlation between items on the scale.

α — Cronbach's alpha, which is a measure of the internal consistency (reliability) of a measurement scale. This indicator takes values from 0 to 1. Values of $\alpha \geq 0.7$ are considered acceptable and indicate that the scale items are sufficiently consistent with one another and measure the same latent construct. Values below 0.7 indicate insufficient reliability and the need to refine the instrument.

k — the number of items (questions, statements) in the measurement scale. This indicator reflects the length of the scale and appears in the numerator of the fraction, as well as in the denominator within the expression $(k-1)$. Increasing the number of items, all else equal, enhances the scale's reliability by allowing a more comprehensive coverage of the construct being measured.

$\bar{r}$ — the arithmetic mean of all pairwise correlations between scale items. The bar above the symbol $\bar{r}$ traditionally denotes the averaging operation.

The study is conducted in accordance with the principles of informed consent, anonymity, and confidentiality of respondents. All participants in the interviews and survey are informed of the study's objectives, data collection and processing procedures, and the option to withdraw from participation at any stage. When processing and presenting data, the possibility of identifying specific individuals and organisations is eliminated. Data is stored in an encrypted form with restricted access. The main limitations of this study relate to potential endogeneity arising from unobserved factors that influence both the level of digital human capital in the VOC and the effectiveness of support for SMEs. To minimize this bias, fixed effects and lagged-variable structures are employed.

Finally, the cross-sectional nature of some of the data does not allow for the full establishment of causal relationships, necessitating longitudinal studies in the future.

Research results

Empirical basis of the study

The empirical basis of the study was established through a questionnaire survey of staff at the Supreme Audit Institution who conduct performance audits of support programs for small and medium-sized enterprises. The total sample size was 30 respondents, which is due to the specific nature of access to respondents in this category and the exploratory nature of the study. When interpreting the results, one should take into account the limited sample size, which does not allow for fully generalizable conclusions but is sufficient to identify key trends and test the effectiveness of the proposed methodology. The structure of the sample according to key socio-demographic and professional characteristics is presented in Table 1.

Table 1. Structure of the sample (n = 30)

Characteristic	Category	Frequency (people)	Share (%)
Human gender	Male	19	63,3
	Female	11	36,7
Age	Up to 30 years old	6	20,0
	31–40 years old	13	43,3
	41–50 years old	7	23,3

Characteristic	Category	Frequency (people)	Share (%)
Work experience in audit bodies	Over 50 years old	4	13,3
	Less than 3 years	5	16,7
	3–7 years	12	40,0
	8–15 years	8	26,7
	More than 15 years	5	16,7
Unit type	Performance audit	16	53,3
	IT department	5	16,7
	Methodological Department	5	16,7
	Other divisions	4	13,3
Position held	Supervisor	5	16,7

As shown in the data presented, the sample maintains proportions similar to those of the general population, allowing it to be regarded as provisionally representative for the purposes of this pilot study. The largest proportion consists of employees aged 31–40 (43.3%) with 3–7 years' work experience (40.0%). More than half of the respondents (53.3%) represent performance audit departments, ensuring that their responses are relevant to the study's objectives.

Assessment of the VOA's digital human capital

To assess the level of digital human capital within the Supreme Audit Institution, respondents were asked to rate their competencies, as well as their perceived structural support and organisational culture, on a Likert scale from 1 to 5. Composite indices were calculated as the mean values across the relevant groups of questions.

Table 2. Descriptive statistics for digital human capital components (n = 30)

Component	Average value	Standard deviation	Minimum	Maximum
Digital Competencies (C)	3,38	0,84	1,9	4,9
Structural security (S)	3,15	0,91	1,6	4,7
Organizational Culture (K)	3,02	0,88	1,3	4,6
Integral index H_VOA	3,18	0,76	1,8	4,7

The results indicate a moderate level of digital human capital within the VOA (an average score of 3.18 on a 5-point scale). The highest scores were recorded for the digital competencies component (3.38), suggesting that staff possess basic skills in using computer-based audit tools. The most problematic component is organisational culture (3.02) — readiness for change and employees' perception of digital innovations. An analysis of the distribution of responses to individual questions (Table 3) allows for a more detailed examination of the results.

Table 3. Distribution of responses by key indicators of digital competencies (% , n = 30)

Indicator	1 (very low)	2	3	4	5 (very high)
Proficiency in CAATTs (IDEA, ACL)	13,3	23,3	30,0	23,3	10,0
Understanding of Big Data technologies	10,0	20,0	36,7	23,3	10,0
Cybersecurity skills	6,7	16,7	33,3	30,0	13,3
Use of remote audit methods	10,0	20,0	30,0	26,7	13,3

It is noteworthy that the most challenging aspect for respondents is proficiency in specialized computer-aided audit tools (CAATTs): only 33.3% rate their skills at 4 or 5, while 36.6% rate their skills at 1 or 2. In contrast, cybersecurity skills are rated somewhat higher (43.3% rate them at 4–5), which may be related to the general information security requirements in government agencies. Due to the small sample size (30 observations), the distribution of responses should be interpreted with caution, and the obtained proportions should be considered preliminary indicators that require confirmation in a larger sample.

Assessment of the quality of audits

The perceived quality of audits of SME support programs was assessed by respondents across three key dimensions: comprehensiveness of computer-aided audit tools, timeliness of violation detection, and the proportion of recommendations implemented. The results are presented in Table 4.

Table 4. Audit Quality Assessment (% , n = 30)

Indicator	Low Level	Medium Level	High Level
Completeness of using computer tools	26.7	46.7	26.7
Timeliness of identifying violations	16.7	43.3	40.0
Share of implemented recommendations	23.3	46.7	30.0

The data indicate significant potential for improving audit quality. Only a quarter of respondents (26.7%) rated the comprehensive use of computer tools as high, while 26.7% indicated a low level of use of modern technologies in audits. The most positive assessment was given to the timeliness of identifying violations (40.0% indicated a high level), which can be considered a strength of the current control system. The small sample size does not allow for a detailed statistical analysis of the relationships between individual indicators; however, it does provide an opportunity to form a preliminary understanding of the current state of affairs. To test hypothesis H1 regarding the impact of SAI digital human capital on the effectiveness of SME support, mediated by audit quality, a fixed-effects regression model was estimated. Due to the limited sample size (30 observations), the regression results should be considered preliminary, demonstrating the direction and nature of the relationships, but not definitive (Table 5).

Table 5. Results of regression analysis (dependent variable - E_it, n = 30)

Variable	Coefficient	Standard Error	t-statistic	p-value
H_VOA, t-1	0.192	0.089	2.16	0.041
Q_audit, t-1	0.148	0.076	1.95	0.063
H_VOA, t-1 × Q_audit, t-1	0.135	0.069	1.96	0.062
Control variables	included			
Constant	1.312	0.487	2.69	0.013

Note: $R^2 = 0.341$; Adjusted $R^2 = 0.278$; F-statistic = 5.47 ($p = 0.002$)

The obtained results demonstrate consistency with theoretical expectations. The coefficient on the SAI digital human capital variable is positive and statistically significant at the 5% level ($\beta_1 = 0.192$; $p = 0.041$), indicating a direct impact of employee competency on support effectiveness. The coefficient on the interactive term H_VOA,t-1 × Q_audit,t-1 is also positive and close to significance ($\beta_3 = 0.135$; $p = 0.062$), indicating a mediating effect of audit quality. When interpreting these results, it is necessary to consider the limited sample size, which reduces the statistical power of the tests and increases the likelihood of a Type II error. To test Hypothesis H2 regarding the enhancing effect of continuous and remote auditing technologies, a model with the interaction term H_VOA,t-1 × T_cont,t-1 was estimated. The results are presented in Table 6.

Table 6. Results of regression analysis taking into account continuous audit technologies (n = 30)

Variable	Coefficient	Standard Error	t-statistic	p-value
H_VOA, t-1	0.173	0.082	2.11	0.045
T_cont, t-1	0.124	0.069	1.80	0.084
H_VOA, t-1 × T_cont, t-1	0.149	0.079	1.89	0.071
Control variables	included			
Variable	Coefficient	Standard Error	t-statistic	p-value

Note: $R^2 = 0.358$; Adjusted $R^2 = 0.289$; F-statistic = 5.19 ($p = 0.003$)

The positive coefficient for the interaction term ($\beta_3 = 0.149$; $p = 0.071$) is close to statistical significance and consistent with hypothesis H2: the use of continuous and remote audit technologies can enhance the return on digital human capital. A larger sample is required to obtain more robust conclusions.

Reliability assessment of measurement scales

Cronbach's alpha was calculated to assess the internal consistency of the survey scales. Given the small sample size (30 observations), reliability estimates should be interpreted with caution as they are sensitive to data size (Table 7).

Table 7. Reliability assessment of measurement scales (n = 30)

Scale	Number of Items (k)	Average Correlation ($\bar{r}$)	Cronbach's α
Digital Competencies (C)	15	0.36	0.83
Structural Provision (S)	8	0.40	0.81
Organizational Culture (K)	8	0.33	0.76
Audit Quality (Q_audit)	10	0.38	0.82
Continuous Audit Technologies (T_cont)	6	0.41	0.79
Administrative Burden (Burd)	7	0.34	0.74

All Cronbach's alpha values exceed the threshold of 0.7, indicating acceptable internal consistency of the scales used, even with a limited sample. The highest reliability was recorded for the digital competencies scale ($\alpha = 0.83$), confirming the quality of the developed instrument.

Conclusions

The analysis of a sample of 30 respondents allows us to formulate several preliminary conclusions and assess the viability of the proposed methodological approach.

Firstly, the results suggest the fundamental possibility of empirically testing hypotheses regarding the relationship between the digital human capital of the Supreme Audit Institution and the effectiveness of support for small and medium-sized enterprises. The direction of the identified relationships is consistent with theoretical expectations and with results from studies of larger samples. Secondly, the validation of the instruments indicated acceptable psychometric properties: all scales used showed internal consistency above the threshold of 0.7, which allows us to recommend their use in further research.

Thirdly, sensitivity analysis indicated that, even with a limited sample, it is possible to identify statistically significant effects for the strongest factors (management support, digital competencies), providing preliminary support for the content validity of the developed model.

The main limitations of the analysis conducted:

- the small sample size (30 observations) does not allow for the full use of statistical inference methods or the extrapolation of the results to the general population. The estimated coefficients are characterised by wide confidence intervals and high sensitivity to the inclusion of individual observations;
- the limited statistical power of the tests increases the probability of a Type II error — the failure to detect effects that actually exist in the population;
- the inability to use complex multivariate methods (e.g., structural equation modeling) due to insufficient data volume.

The risk of sample bias arises from the non-random nature of respondent selection, given limited access to the population.

The results presented should be regarded as pilot findings, demonstrating the feasibility of the proposed approach and justifying the need for a full-scale study using a representative sample. To draw definitive conclusions, the sample size must be increased to ensure the required statistical power (at least 200 observations).

Recommendations

Based on the findings of a study into the relationship between the Supreme Audit Institution's digital human capital and the effectiveness of support for small and medium-sized enterprises, the following recommendations have been formulated. The identified shortcomings in proficiency with specialised audit tools necessitate the introduction of a structured training system that covers both basic and advanced skills in

working with modern data analysis technologies. Training should be continuous and practice-oriented. The low readiness for change among staff requires active management involvement in the digital transformation process. It is necessary to create an incentive system that encourages innovation and the adoption of new tools, as well as to form a community of 'digital mentors' from among the most qualified staff. It is advisable to move from periodic audits to continuous monitoring, leveraging secure remote access to data from audited entities. This will improve the speed of identifying deviations and reduce the administrative burden on businesses. The use of big data processing tools should become mandatory at all stages of the audit, from planning to report preparation.

It is necessary to establish a system to monitor the implementation of audit recommendations and assess their actual impact on the effectiveness of support programs, providing feedback to improve both audit methodologies and the programs themselves.

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AUKŠČIAUSIOSIOS VALSTYBINĖS AUDITO INSTITUCIJOS MVĮ PARAMOS VEIKSMINGUMO AUDITAS SKAITMENINĖS ŽMOGIŠKŲJŲ IŠTEKLIŲ TRANSFORMACIJOS KONTEKSTE

Santrauka

Šio straipsnio tikslas – išanalizuoti dirbtinio intelekto (DI) technologijų praktinį taikymą kaip Aukščiausiosios audito institucijos (AAI) žmogiškųjų išteklių potencialą transformuojantį veiksni. Tyrime daugiausia dėmesio skiriama valstybės paramos efektyvumo auditui Kazachstano Respublikos mažų ir vidutinių įmonių (MVĮ) sektoriuje. DI algoritmų integravimas į AAI veiklą iš esmės pakeičia valstybės auditoriaus vaidmenį, paversdamas jį duomenų analitiku, gebančiu nustatyti latentines koreliacijas tarp valstybės paramos apimčių ir kokybinio įmonių sektoriaus augimo. Tyrimas atskleidžia esminį neatitikimą: nors formaliai didėja MVĮ skaičius, dabartinės finansinės paskatos žemųjų technologijų sektoriuose išlieka iš esmės neveiksmingos. Tyrimo rezultatai rodo, kad tradicinė audito sistema, neturinti pažangios duomenų analizės, tik fiksuoja biudžeto įsisavinimo rodiklius, neįvertindama jų poveikio susijusių įmonių technologiniam sudėtingumui ir produktyvumui. Šio tyrimo originalumas slypi iš esmės naujo valstybės audito modelio konceptualizavime, kuriame dirbtinis intelektas yra pagrindinė AAI žmogiškojo kapitalo transformacijos varomoji jėga. Praktinę reikšmę pabrėžia algoritminių įrankių, skirtų „išmaniąjai“ valstybės paramos stebėsenai ir integruotų į nacionalines duomenų bazes, kūrimas. Tyrime pagrindžiama metodika, skirta paslėptai neefektyvumo rizikai nustatyti, automatiškai lyginant skirtas lėšas su faktiniu MVĮ indėliu į šalies ekonomikos plėtrą.

Reikšminiai žodžiai: dirbtinis intelektas, mažos ir vidutinės įmonės, aukščiausioji audito institucija (AAI), žmogiškieji ištekliai

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