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Cost-effectiveness of introducing artificial intelligence tools into verbal evidence processes

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ABSTRACT

The relevance of this study stems from the need to improve the economic efficiency of law enforcement agencies in the context of the digital transformation of public administration. The transition to electronic pre-trial proceedings and the growing volume of verbal information processed make it necessary to implement artificial intelligence tools that can reduce the labor intensity of procedural procedures, optimize the use of human and budgetary resources, and increase the productivity of investigative units. The aim of the study is to assess the economic efficiency of implementing artificial intelligence tools in verbal procedural procedures based on an analysis of the dynamics and regional structure of pre-trial investigations in the Republic of Kazakhstan. The study utilized statistical and economic-mathematical analysis methods, including the calculation of absolute and relative dynamics indicators (Δ, %Δ, CAGR), structural shares of regions, and a model for assessing the savings in investigator work time. Based on data for 2019–2025, a steady decline in the overall number of pre-trial investigations was established, with the electronic format dominating from 2022. A regional analysis revealed a concentration of procedural workload in cities of national significance and industrially developed regions, where the implementation of AI provides the greatest economic benefit. Calculations show that the automation of verbal procedural procedures frees up a significant amount of investigator time, equivalent to a significant reduction in the need for additional human resources. The obtained results confirm that the implementation of artificial intelligence tools in verbal procedural procedures is economically feasible and contributes to the optimization of public spending, increased productivity, and the rationalization of procedural workload. The need for a

differentiated regional approach to the implementation of AI solutions, taking into account the scale and dynamics of pre-trial investigations, is substantiated. The results of the study can be used in the development of programs for the digitalization of the law enforcement system and subsequent cost-benefit analysis and return on investment calculations.

INTRODUCTION

In the context of the digital transformation of the economy and public administration, the implementation of artificial intelligence (AI) tools is becoming a key factor in improving the efficiency of public and law enforcement processes. This trend is particularly significant in criminal proceedings, which traditionally remain highly labor-intensive, time-consuming, and place significant burdens on budgets and human resources.

Verbal procedural procedures (questioning, interviews, confrontations, recording and analysis of testimony) are among the most resource-intensive elements of procedural activity, as they require significant time, the participation of qualified specialists, and the subsequent analytical processing of large amounts of textual information. With the growing volume of criminal cases and the increasing complexity of the evidence base, there is an objective need to find technological solutions that can increase productivity, reduce costs, and ensure a more efficient use of public resources. Despite the rapid development of AI technologies (speech recognition, automatic transcription, text analysis, and detection of logical contradictions), their economic efficiency in the context of verbal procedural procedures remains understudied, especially in developing economies and resource-constrained government systems.

The aim of this study is to assess the economic efficiency of implementing artificial intelligence tools in verbal procedural procedures in terms of cost optimization, increased productivity, and improved evidentiary processing in the criminal justice system.

The practical significance of this study lies in the potential use of the obtained results:
- in justifying the feasibility of budget investments in the digitalization of law enforcement agencies;
- in developing economic and organizational models for implementing AI in procedural activities;
- for developing key performance indicators (KPIs) for digital solutions in law enforcement;
- in the activities of government agencies when planning digital reforms and optimizing administrative costs;
- in educational and scientific-practical programs related to the digital economy, public administration, and law.

The results of the study can be used in the preparation of strategic documents, digitalization programs, and methodological recommendations for law enforcement and judicial authorities.

1. RESEARCH METHODS

The methodological basis of the study was developed taking into account the interdisciplinary nature of the work and combines economic, statistical, analytical, and modeling methods aimed at assessing the cost-effectiveness of implementing artificial intelligence tools in verbal procedural procedures of pre-trial proceedings.

1. Analysis of Official Statistical Data

The empirical basis of the study was official statistical data from the Legal Statistics and Special Records Portal of the Republic of Kazakhstan, reflecting the dynamics of initiated pre-trial investigations, their regional structure, and the degree of transition to electronic formats for the period 2019–2025. The use of official sources ensured the reliability and comparability of the analyzed indicators.

2. Descriptive Statistical Methods

The first stage utilized descriptive statistical methods, including the analysis of absolute and relative indicators, the construction of time series, and the calculation of the structural shares of regions in the national volume of pre-trial investigations. This stage allowed us to identify general trends in digitalization and regional differentiation of the procedural workload.

3. Dynamic Analysis and Calculation of Change Rates

To assess the intensity of change, dynamic analysis methods were used, including the calculation of:
- Absolute changes in indicators (Δ);
- Relative changes (%Δ);
- Compound Annual Growth Rate (CAGR).

The use of these indicators allowed us to characterize the rate of transformation of pre-trial proceedings and assess the sustainability of the identified trends in the medium term.

4. Structural Analysis and Regional Typology

To identify territorial disparities and priority areas for AI implementation, a structural analysis of the distribution of pre-trial investigations by region was conducted. Additionally, cluster analysis (hierarchical clustering using Ward's method) was used to group regions by level of procedural burden (high, medium, and low). This allowed us to develop a typology of regions and justify a differentiated approach to digitalization.

5. Economic and Mathematical Modeling of Time Savings

A key element of the study was the development of a model for assessing the savings in investigator work time when implementing artificial intelligence tools in verbal procedural procedures. Time savings were calculated as a function of:
- the volume of pre-trial investigations in the region;
- the share of electronic formats;
- the average intensity of verbal procedures;
- the reduction in labor costs per procedure due to AI.

The resulting values were interpreted as full-time equivalents (FTE), allowing for an assessment of the impact of digitalization in terms of freed-up human resources.

6. Methods of Economic Evaluation of Effectiveness (CBA and ROI)

To interpret the results from an economic perspective, elements of cost-benefit analysis and return on investment calculations were used. The economic impact was determined through the monetization of freed-up work time using a range of costs per hour of investigator labor, which ensured the flexibility of scenario analysis.

7. Scenario and Comparative Analysis

The study utilized a scenario approach (conservative, baseline, and optimistic) to assess the sensitivity of the results to changes in key model parameters (procedure intensity, share of electronic format, and time savings). A comparative analysis of the results by region identified areas of maximum and minimum economic benefit from AI implementation.

2. RESEARCH BACKGROUND

According to Brandao, P. R. (2025) In recent years, artificial intelligence (AI) has become a transformative force in various sectors of modern society, changing the economic landscape, social interactions and ethical aspects. This article examines the multifaceted impact of AI, analyzing its impact on employment, privacy, and decision-making processes. Organizations around the world are using these AI capabilities to increase productivity. Seventy-four percent of companies using AI claim that it has given them a competitive advantage. Many companies have started using AI to automate administrative and engineering design tasks. For example, legal AI algorithms can find relevant legal cases, draw up contracts based on templates, and analyze the language for problems.

AI has the potential to bring about fundamental changes in humanity. For example, many decisions in a person's life can already be delegated to technology. As AI systems improve, these systems can perform more complex tasks. The risk is that much of human judgment can be transferred to AI agents, forcing people to follow the guidance of smart agents without question. Independent human judgment allows you to reflect values, contexts, and long-term perspectives. At the same time, AI systems tend to focus on short-term goals, often overlooking secondary effects such as spirals and backlash (Velarde, 2019).

Understanding the political implications of algorithmic governance also helps to assess the political structures involved. AI and related technologies can have unintended consequences for organizational, institutional, social, and economic aspects of governance. Relying solely on the technical design of AI for management can also lead to immediate negative political consequences. To ensure that AI does not exacerbate existing political tensions or create new ones, it must meet clearly defined, legally established political goals. The high-dimensional input state space supports the modeling of complex systems. However, in such decision-making conditions, poor AI specification can lead to negative management consequences. These systems can also harm political representation (Sætra, 2020).

The development and implementation of artificial intelligence (AI) in the field of verbal evidence confirms the pronounced multidisciplinary and interdisciplinary nature of modern research, covering legal, technological, managerial and economic aspects. A significant body of literature is devoted to the use of automatic speech recognition (ASR) and natural language processing (NLP) technologies for recording and analyzing oral evidentiary information in law enforcement. So, the research of Harrington L. (2023) demonstrate that the use of ASR in transcribing investigative interviews can significantly reduce the complexity of documentation, however, the quality of automatic transcription significantly depends on the recording conditions, speech characteristics and the context of the interrogation. In the same context, Stoykova R., Porter K., Beka T. (2023) it is emphasized that the legal admissibility and procedural reliability of such decisions require regulatory regulation and built-in quality control mechanisms, which is especially important in the context of the implementation of the provisions of the AI Act and similar initiatives in the law enforcement sphere.

A separate area of research focuses on the intellectual analysis of the content of verbal evidence. Using NLP methods, an automated assessment of the characteristics of witness testimony becomes possible, including the degree of confidence of eyewitnesses and the features of linguistic expression, which expands the analytical capabilities of pre-trial proceedings (Greenspan et al., 2024). In related papers, Sola-Sales (2023) showed that linguistic styles and speech patterns can be used to identify signs of unreliability or distortion of memories, which is important for assessing the evidentiary value of oral testimony. At the same time, the authors emphasize that such tools should be considered as auxiliary, rather than replacing the procedural discretion of the investigator or the court.

The creation and continuous improvement of the information space is becoming one of the key factors of sustainable development. The development of digital solutions promotes organizational transformations, changes business paradigms and forms new models of service and interaction.

Han et al. (2024) considers new digital infrastructure as the cornerstone of the formation of an innovative environment. It facilitates the transition to green, low-carbon, and smart development in the context of the digital economy. Organizations providing information technology (IT) services play a crucial role in economic growth and job creation.

The transition to an electronic pre-trial format serves not only as a tool for increasing the transparency and manageability of processes, but also as a technological foundation for the further automation of analytical and documentary operations at the pre-trial stage. In particular, studies devoted to the use of electronic information technologies in the activities of internal affairs agencies during pre-trial proceedings note the need for the systematic development of electronic document management and digital accounting systems to improve the effectiveness of preliminary investigations and the quality of procedural decisions. A separate line of research examines the digitalization of judicial and law enforcement activities in Kazakhstan as an institutional reform that changes the organization of processes, reduces transaction costs, and creates the conditions for the subsequent implementation of intelligent technologies based on accumulated data.

The digitalization of criminal proceedings and the introduction of artificial intelligence (AI) tools into the activities of law enforcement agencies are considered in modern scientific literature as one of the key factors in increasing the efficiency of public administration and optimizing the use of public resources. With the growing volume of processed information and the increasing complexity of the evidence base, the automation of verbal procedural procedures, traditionally characterized by high labor intensity and significant time costs, is acquiring particular importance (Lohr, 2020).

In the regulatory framework of the Republic of Kazakhstan, the digital transformation of the law enforcement system is enshrined in strategic and programmatic documents, including the State Program "Digital Kazakhstan" and the Concept for the Development of Artificial Intelligence for 2024-2029. The Criminal Procedure Code of the Republic of Kazakhstan permits the use of electronic forms of recording and storing procedural materials, which creates the institutional preconditions for the implementation of intelligent digital tools at the pre-trial stage. The practical implementation of these provisions is reflected in the statistics of the legal statistics and special records portal, demonstrating a sustainable transition to an electronic format for pre-trial investigations. International studies emphasize that AI in the public sector has the greatest economic impact in processes involving the processing of large amounts of text and speech information, where automation can significantly reduce labor costs (Duan et al., 2019; Sun et al., 2019). In particular, automatic speech recognition (ASR) and natural language processing (NLP) technologies are considered a fundamental technological building block for optimizing the documentation, analysis, and structuring of verbal information.

A number of studies have explored the use of ASR and NLP in law enforcement and judicial processes. Researchers note that automated transcription of interviews, interrogations, and surveys can reduce the time required to prepare procedural documents, improve the completeness of testimony recording, and reduce the burden on employees performing routine operations (Leo et al., 2020).

From an economic point of view, the introduction of AI into verbal procedural procedures is interpreted through the prism of increasing labor productivity and reducing transaction costs. In the works devoted to the economics of digital technologies, it is emphasized that the main contribution of AI is not to replace a person, but to free up his working time to perform more complex analytical and managerial tasks. This approach is especially relevant for the law enforcement sphere, where a significant part of the investigator's working time is associated with the processing and analysis of textual information.

Bibliometric and review papers confirm that the greatest contribution of AI in the public sector is associated with increased efficiency of decision-making and analytical support for government activities (Di Vaio et al., 2022). The concept of "smart governance" emphasizes that the integration of AI, data analytics, and digital platforms increases the adaptability and transparency of public administration, including law enforcement (Jiang, 2021).

International organizations, including the OECD and the World Bank, recommend evaluating the effects of AI in public administration through indicators of saving time, increasing process throughput, and optimizing budget expenditures. In this regard, the transfer of released working time to full-time equivalent (FTE) is considered as a correct tool for the economic interpretation of the results of digitalization.

Kazakh research focuses on both legal and economic aspects of the digitalization of criminal proceedings. The authors emphasize that the transition to an electronic format of pre-trial proceedings contributes to increased transparency, manageability and procedural discipline, while creating conditions for the introduction of intelligent analytical tools. At the same time, it is noted that there is a need for an economic assessment of digital reforms, since the effect of technology implementation varies significantly depending on the regional workload and organizational maturity of departments.

At the same time, the literature highlights the risks and limitations of the use of AI in the law enforcement sphere related to requirements for data quality, transparency of algorithms, protection of the rights of participants in the process and error management (Sun, 2019), (Meijer, 2019). This indicates the need to include in economic calculations not only direct benefits, but also the costs of quality control, staff training and regulatory compliance.

The main challenge in the cost-effectiveness of implementing AI in verbal procedural procedures is the gap between technological readiness (electronic format, data, ASR/NLP tools) and the system's managerial and legal readiness. This means that the expected effect (time savings, increased productivity, cost reduction) often fails to translate into a sustainable ROI. This gap manifests itself in several bottlenecks:

1) The metric of "digitalization" replaces the metric of "efficiency."
The growth of the electronic format does not in itself guarantee savings: if investigators still spend time on manual proofreading, retyping, duplicating data across multiple systems, or correcting speech recognition errors, then AI becomes an "add-on" rather than a replacement for routine operations.

2) Data quality and the legal significance of the result.
AI transcription/summarization can introduce errors (noise, dialects, overlapping speech, legal terminology). If the verification procedure isn't integrated into the system, the following risks arise:

- either "overinsurance" (checking everything manually → the effect almost disappears);
- or "trust without control" (errors → procedural risks and challenging evidence).

3) Uneven regional workload and digital maturity.
Data shows that the workload is concentrated in a few regions. A universal implementation "the same everywhere" leads to overspending in regions with low workloads and underinvestment in areas where the effect is greatest.

4) The economic effect is not "monetized" in the management cycle.
Even if man-hours are freed up, the system often doesn't translate them into measurable results (reduced timeframes, improved quality, reduced overload). Without KPIs and process changes, savings remain "on paper." AI in verbal procedural procedures is economically feasible, but only if its implementation is interpreted not as "digital modernization" but as business process reengineering (BPR): regulations, role distribution, quality control, and outcome indicators are changed.

Thus, an analysis of scientific sources allows us to conclude that the economic efficiency of implementing artificial intelligence tools in verbal procedural procedures is determined by a combination of three factors: the presence of an electronic procedural framework, the technological maturity of ASR and NLP solutions, and a correct economic assessment of the effects through CBA and ROI models. This justifies the methodology chosen in this study, based on an analysis of the procedural workload, calculation of savings in investigator work time, and regional differentiation of the effects of digitalization.

3. ANALYSIS AND RESULTS

Let's consider the share of electronic formats and growth rates, which reflect the portion of procedural actions that are technologically feasible for AI application. In economic terms, this is:

- the upper limit of scalability of AI solutions;
- the actual volume of processes where savings in labor and transaction costs are possible.

In a paper-based document flow, the implementation of AI does not lead to a systemic economic effect. On the contrary, an increase in the share of electronic formats:

- expands the data set for automatic processing;
- reduces the marginal cost of processing one unit of information;
- creates conditions for the standardization of verbal procedures.

Consequently, the share of electronic formats is a key prerequisite for achieving economic benefits from AI, rather than a secondary technological indicator (Table 1).

Table 1. Share of electronic format and growth rates of pre-trial investigations in the Republic of Kazakhstan (2015–2025)

Year	Total, in thousands	In electronic format	Share of electronic format, %	Total Growth Rate (YoY)	Electronic Format Growth Rate (YoY)
2015	373	0	0	-	-
2016	345	0	0	-7,5	-
2017	298	0	0	-13,6	-
2018	274	13	4,7	-8,1	-
2019	231	44	19,0	-15,7	+238,5
2020	157	68	43,3	-32,0	+54,5
2021	149	114	76,5	5,1	+67,6
2022	149	149	100	0,0	+30,7
2023	133	133	100	-10,7	-10,7
2024	127	127	100	-4,5	-4,5
2025	116	116	100	-8,7	-8,7

Source: compiled by the authors

An analysis of the share and growth rate of the electronic format:

- enables prioritization of regions and departments for AI implementation;
- serves as an argument for differentiated digital policies rather than one-size-fits-all solutions;
- provides a basis for the phased implementation of AI depending on digital maturity.

1. The growth rate of the electronic format reflects the speed at which investments in digitalization begin to yield economic results. In the context of CBA and ROI:

- high growth rates indicate a rapid expansion of the base on which AI reduces costs;
- low growth rates increase the payback period and reduce the cumulative effect.

2. The sharp increase in the share of the electronic format in 2019–2021 indicates a scaling phase, in which:

- fixed implementation costs (training, software, infrastructure) begin to be spread across the growing volume of cases;
- the average cost of processing one verbal procedural action decreases. 3 The share of electronic formats and their growth are directly related to the economics of working time:
- the electronic format reduces the time it takes to record, transcribe, and analyze testimony;
- AI tools (speech-to-text, NLP analysis) enhance this effect not linearly, but exponentially as the volume of data grows.

Thus:

- with a low share of electronic formats, AI has a localized effect;

- with a share of >70–80%, AI becomes a systemic factor in increasing the productivity of investigative units. 4 CAGR (Compound Annual Growth Rate)

- Total CAGR (2015-2025)

$CAGR$=(116 / 373)$^{1/10}$ - 1 ≈ -11.0% per year

- Electronic Format CAGR (2018-2025)

$CAGR$=(116 / 13)$^{1/7}$ - 1 ≈+36.7% per year

The total volume of initiated investigations is declining by approximately 11% per year, while the electronic format (as an infrastructural basis for AI) is growing by an average of 36–37% per year during the scaling period from 2018 to 2025.

3.1 Assessment of the economic efficiency of the implementation of artificial intelligence tools

Analyzing the share of electronic formats and their growth rates is crucial for assessing the economic efficiency of implementing artificial intelligence tools in verbal procedural procedures. The share of electronic formats reflects the actual scale of processes available for automation, while growth rates characterize the speed of cost transformation and the time it takes to achieve economic benefits. Collectively, these indicators form a methodological basis for accurately calculating CBA and ROI, and allow AI to be viewed not as a technological innovation, but as a factor in increasing labor productivity and optimizing public spending.

This transition is crucial for the economic evaluation of digitalization and the implementation of artificial intelligence tools in verbal procedural procedures, as the workload of law enforcement agencies, the crime structure, and the intensity of procedural actions vary significantly across regions. Consequently, identical digital solutions may demonstrate different economic returns depending on territorial conditions, the level of urbanization, the density of office work, and the staffing of investigative units. To substantiate the economic efficiency of digitalizing pre-trial proceedings and integrating artificial intelligence tools into verbal procedural procedures, an important stage of the analysis is comparing the volume of criminal cases investigated electronically with the number of cases referred to court. This comparison allows us to assess not only quantitative changes in procedural activity but also structural shifts in preliminary investigation mechanisms, reflecting the transformation of costs, labor intensity, and the effectiveness of procedural actions.

Table data for 2019–2024 document the dynamics of the transition to electronic investigations and allow us to determine the proportion of cases reaching the trial stage, which is fundamental for the economic interpretation of the implementation of digital and intelligent technologies. In the context of this study, this indicator is considered an indirect indicator of the effectiveness of pre-trial filtering and the quality of analytical processing of materials, including the use of automated tools for analyzing verbal information (Table 2).

Table 2. Pre-trial investigations in electronic format and the share of cases sent to court

Year	Criminal cases investigated (electronic format), units	Sent to court, units	Share of cases sent to court, %
2019	20309	5844	28,78
2020	68487	10391	15,17
2021	115811	13417	11,59
2022	164135	16443	10,02
2023	133000	12000	9,0
2024	127000	10800	8,5

Source: compiled by the authors

An analysis of the ratio of cases investigated to those referred to court provides an empirical basis for assessing the potential savings in labor and time resources achieved through digitalization and the use of AI in the pre-trial stage. A decrease in the proportion of cases referred to court, coupled with an increase

in the volume of electronic investigations, indicates a redistribution of the workload within the criminal justice system and creates the basis for calculating cost-benefit analysis (CBA) and return on investment (ROI) indicators for the implementation of AI solutions for the automation of verbal procedural procedures.

Regional differentiation allows for a transition from average national indicators to an analysis of the marginal effectiveness of AI implementation, identifying regions where the automation of verbal procedures provides the greatest reduction in labor and transaction costs. In economic terms, this means the ability to compare the volume of pre-trial investigations with potential savings in labor time and budgetary resources, as well as to assess the variability of CBA and ROI indicators across regions.

Regional analysis provides the basis for developing a differentiated digitalization model, where the priority for implementing AI tools is determined not by formal criteria, but by the actual procedural workload and digital maturity of regional divisions. This approach allows us to view artificial intelligence not as a universal technological solution, but as an optimization tool adapted to the economic conditions of specific regions, thereby improving the validity of management decisions and the efficiency of public resource allocation.

The grouping of regions by workload type (high/medium/low) is shown in Figure 1.

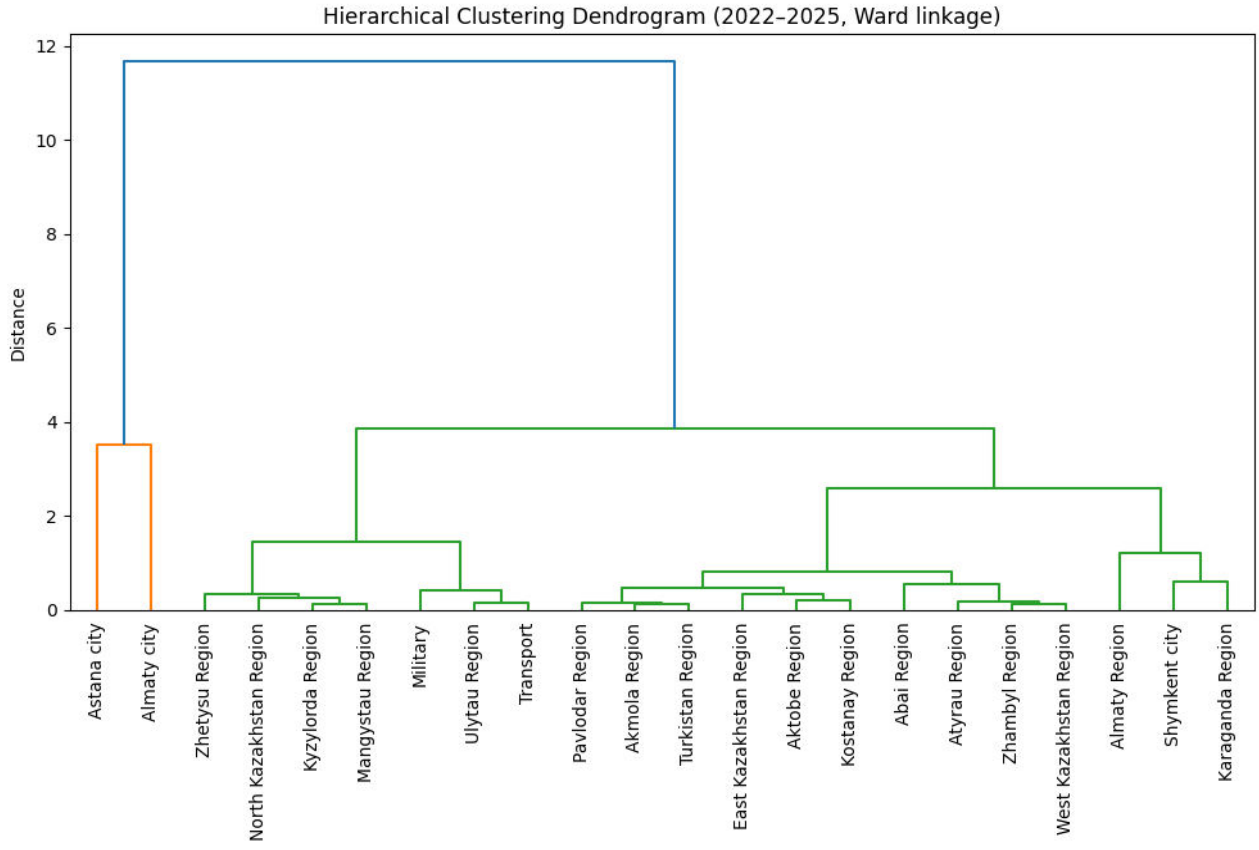

Figure 1. Grouping of regions by load type
Source: compiled by the authors based on calculations

The dendrogram provides insight into the following:

1) High Load:

- this is the number one priority for AI implementation (speech-to-text, automatic protocol, NLP analysis of testimony) because the caseload is highest, meaning greater scalability and faster time/cost savings;
- a high ROI is most likely here: fixed implementation costs (integration/training/licenses) are "spread" over a large caseload.

2) Medium Load:

- the optimal strategy is to scale standard solutions after the High Load pilot, but with adaptation to regional specifics (staffing, crime structure, seasonality);
- the economic effect is expected to be stable, but the ROI will depend on the intensity of verbal procedures (interrogations/questioning/confrontations) in a particular region and the degree of standardization of the processes.

3) Low-load:

- for these areas, lightweight solutions are more rational: a centralized transcription service, protocol templates, and targeted NLP analysis, rather than expensive, complex on-site implementations;
- economic logic: with small caseloads, the payback period is longer, so the emphasis is on minimizing CAPEX and using shared platforms/competence centers.

3.2 Modelling of economic effects of digitalization and the implementation of artificial intelligence tools

To fully assess the economic impact of digitalization and the implementation of artificial intelligence tools in verbal procedural procedures, analyzing the absolute volume of initiated pre-trial investigations alone is insufficient. Research into the structural and dynamic heterogeneity of regions, reflecting differences in procedural burden, the speed of transformation, and the contribution of individual administrative-territorial units to the national total, is essential.

The Δ indicator characterizes the absolute redistribution of pre-trial investigation volumes between regions, while %Δ and CAGR reflect the intensity of institutional and procedural changes, including the impact of digitalization and organizational reforms. The regional share indicator in 2025, in turn, captures the structural concentration of procedural activity, which is fundamental for prioritizing the implementation of AI solutions and assessing potential savings in labor and budgetary resources.

It should be noted that for regions formed as a result of administrative-territorial transformations after 2021, dynamic indicators for 2019–2025 were not calculated due to the lack of a comparable baseline value, ensuring the methodological correctness of the analysis and eliminating distortions in conclusions associated with formal structural breaks in statistical series. This expanded regional analysis provides an empirical basis for the subsequent classification of regions by procedural workload and allows for a differentiated approach to the implementation of artificial intelligence tools in verbal procedural procedures based on economic efficiency, return on investment, and optimization of public expenditures.

To assess the economic efficiency of implementing artificial intelligence tools in verbal procedural procedures, it is crucial to analyze not only the dynamics of pre-trial investigations but also the amount of labor resources saved, measured in investigator time. In this regard, the table presents an estimated regional estimate of potential savings in investigator time for 2025, based on the actual volume of pre-trial investigations initiated and the prevalence of electronic case management.

Time savings are calculated as a function of the region's procedural workload, the average intensity of verbal procedures, and the effect of their automation using AI tools (automated transcription, intelligent text processing, protocol templates). This approach allows digitalization to be interpreted not as an abstract technological improvement, but as a measurable economic effect, expressed in hours of freed labor and full-time equivalents (FTE).

These indicators allow us to compare regions by the absolute volume of potential time savings, identify areas with the greatest concentration of benefits, and justify the priority of implementing AI solutions in the context of limited budgetary resources. In the context of this study, this table forms the empirical basis for subsequent cost-benefit analysis (CBA) and return on investment (ROI) calculations, as well as for

developing a differentiated model for the digitalization of verbal procedural procedures in the criminal justice system of the Republic of Kazakhstan (Table 3).

Table 3. Time savings by leading regions of the Republic of Kazakhstan for 2025

Region	Beginning 2025	Share 2025	Saving time, hours	Full-time equivalent, FTE
Almaty city	20495			
Astana city	14830	12,8	35592	20,2
Almaty	8382	7,2	20117	11,4
Karaganda	7434	5,5	15442	8,8
Shymkent city	5725	4,9	13740	7,8
Aktuibinsk	5345	4,6	12828	7,3
Pavlodar	5040	4,3	12096	6,9
Kostanay	4870	4,2	11688	6,6
Akmola	4717	4,1	11321	6,4
Turkestan	4666	4,0	11198	6,4

Source*:* compiled by the authors

Time savings amounted to 278,016 hours/year

Full-time equivalent ≈ 158 FTE

To calculate time savings for leading regions of Kazakhstan for 2025, the following were used:
- S2025≈1.0 (share of electronic format ≈ 100%)
- average number of verbal procedures per case: m=3
- labor costs for 1 verbal procedure before AI: t0=2 hours
- after the implementation of AI (transcription + protocol templates + fact extraction):t1=1.2 hours.

Save time on 1 task:

$\Delta\tau = m \cdot (t0 - t1) = 3 \cdot (2.0 - 1.2) = 2.4$ hours/case

annual time savings in the region:

$\Delta Tr,2025 = Nr,2025 \cdot s2025 \cdot 2.4$

Using an estimated cost per hour of investigator labor in the range of 4,000-7,000 tenge/hour (salary + accruals + overhead), the potential economic impact is:
- at 4,000 tenge/hour ≈ 1.11 billion tenge/year;
- at 7,000 tenge/hour ≈ 1.95 billion tenge/year.

The 2025 share shows where the greatest absolute time savings will be—the pilot/scaling priority (in your case: Almaty, Astana, Almaty region, Karaganda region).

CAGR and %Δ (2019–2025) allow you to assess whether the impact will be sustained: with a rapid decline in Nr, the potential savings decrease, and the payback period lengthens. Δ(2019–2025) reflects the redistribution of workload between regions and helps justify why a unified AI implementation strategy is ineffective (a differentiated approach is needed).

Regional indicators of initiated pre-trial investigations are used as a proxy indicator of procedural workload, determining the potential savings for investigators' time by integrating AI into verbal procedural procedures. Given the dominance of the electronic format in 2022–2025, AI applicability in 2025 is assumed to be close to 100%, and annual time savings are estimated using the model $\Delta Tr = Nr \cdot m \cdot (t0 - t1)$. Calculations show that the maximum concentration effect is achieved in the regions with the highest share in 2025 (large agglomerations and industrial regions), which forms the basis for prioritizing implementation and subsequent calculation of CBA/ROI.

CONCLUSION

The economic efficiency of implementing artificial intelligence tools in verbal procedural procedures is determined by their ability to measurably reduce labor and time costs while simultaneously improving the quality of pre-trial proceedings.

An analysis of the dynamics and regional structure of pre-trial investigations in the Republic of Kazakhstan for 2019–2025 revealed that, despite a steady decline in the overall number of investigations, a qualitative transformation of pre-trial proceedings is taking place, driven by the transition to an electronic format and the digitalization of procedural procedures. This process creates the institutional and technological preconditions for implementing artificial intelligence tools in verbal procedural actions as a key factor in increasing the economic efficiency of criminal proceedings.

A regional breakdown revealed a high concentration of procedural workload in a limited number of territories, primarily in cities of national significance and industrially developed regions. It is in these territories that the potential impact of automating verbal procedures is greatest due to their widespread applicability and the potential to reduce specific labor costs per case. Calculations show that the implementation of AI tools can provide significant savings in investigators' work time, equivalent to hundreds of thousands of man-hours per year, which can be interpreted as a significant release of human resources without increasing staffing levels.

A comparison of absolute and relative growth rates (Δ, %Δ, CAGR), as well as the share of regions in the national total, made it possible to substantiate the need for a differentiated approach to digitalization. Universal solutions prove less cost-effective than targeted implementation of AI in regions with a stable or high procedural workload, while for territories with low investigation volumes, centralized or modular digital services are more rational.

Overall, the obtained results confirm that the introduction of artificial intelligence into verbal procedural procedures should be viewed not only as a technological innovation, but also as an economic tool for optimizing public spending, increasing labor productivity, and rationally allocating law enforcement resources. This creates a scientifically sound basis for subsequent cost-benefit analysis and return on investment calculations, as well as for the formation of management decisions in the field of digital transformation of criminal proceedings in the Republic of Kazakhstan.

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