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Forensic Expertise Digitalization and The Use of Modern Technologies

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Abstract
The article presents a scientific analysis of reforms aimed at modernizing forensic expert activity in the Republic of Uzbekistan, their legal foundations, the processes of digitalization of forensic expert activity, as well as the main problems encountered in practice. The author scientifically substantiates that the harmonious development of the forensic expert system in line with global trends and the digitalization of activities are important factors in increasing the effectiveness of justice.

Keywords: digitalization, artificial intelligence, digital evidence, electronic databases, the "E-Expertise" electronic platform, digital forensics, electronic expertise, institutional reforms.

Introduction

In the current context of global digitalization, the field of forensics is also undergoing a radical transformation through the introduction of modern information and communication technologies. Digitalization of forensics is understood as the systematic use of digital technologies in the processes of assigning, conducting, documenting, storing and exchanging expertise [1].

From a scientific point of view, digitization serves to ensure the transparency, efficiency, accuracy of forensic activities, the integrity of evidence, and the reduction of the influence of the human factor. In particular, digital evidence, electronic databases, and automated analysis tools increase the scientific level of expert opinions. [2].

Digitization in the field of forensic expertise implies, first of all, the transition from traditional paper circulation to electronic information systems.

This brings about the following important changes:

Firstly , it will be possible to prepare and store expert opinions in electronic form . This will reduce the risk of loss, forgery or alteration of documents;

secondly , electronic databases will expand the possibilities for reusing the results of previously conducted examinations and conducting comparative analysis;

third , automated analysis tools (e.g., biometric analysis, digital traceology, DNA databases*)* increase the scientific level of expertise;

fourth , the digitization of forensic processes optimizes the exchange of information between judicial, investigative, and expert institutions;

Fifth , it will significantly reduce the time spent on conducting forensic examinations, eliminating unnecessary paperwork, postage costs, and bureaucratic hassles in the formalization of forensic examination reports.

In foreign countries, the digitization of forensic activities is considered a priority in the development of legal systems and an important factor in increasing the efficiency of justice. This process is associated with the introduction of technologies and methodologies necessary for the collection, storage, analysis and preparation of "electronic evidence" for admissibility in court.

The digitalization of forensic science will only be effective if it is carried out on the basis of a harmonious combination of legislation, institutional framework and technical standards [3]. The use of digital technologies in forensic science in the countries of the European Union is based, first of all, on the principles of protecting human rights and ensuring procedural guarantees [4].

In some European countries, technical guidelines have been developed for the collection and preservation of electronic evidence, especially through legally established standards. In particular, the implementation of ISO/IEC 27041 and ISO/IEC 27042 standards is helping to increase the reliability of digital forensics in European countries [5].

The creation of a common legal framework and the development of more consistent standards for working with electronic evidence, the establishment of rules for the exchange of information between judicial and investigative bodies and the proper storage of electronic evidence, and the protection of human rights when working with electronic evidence have been established as important principles for the countries of the European Union.

The United States is one of the most advanced countries in the implementation of digital technologies in forensics. The practice of working with electronic evidence in the United States is largely based on court precedents and specific scientific and technical standards [6].

Artificial intelligence and automated analysis systems are widely used as a tool to support expert work.

The level of use of digital technologies in forensics in Asian countries varies from country to country. In economically developed countries such as Japan and South Korea, digital data analysis and automated forensics processes are at an advanced level.

The main features of the Asian experience are the presence of centralized state-owned digital expertise platforms, the widespread use of artificial intelligence and big data technologies, and the reduction of expertise times through the automation of expert activities [7].

This experience shows that priority is given to technological innovations in the digitalization of forensic activities.

International practice shows that in developed countries,forensic activities are being organized on the basis of digitalization. For example, electronic forensic platforms are widely used in the European Union, unified standards for working with digital evidence in the United States, and forensic analysis systems based on artificial intelligence are widely used in South Korea and Japan. These international practices are aimed at minimizing the impact of the human factor in forensic activities, reducing the likelihood of errors, and improving the quality of court decisions.

The introduction of ISO/IEC standards in the fields of digital forensics and electronic forensics is also contributing to the international recognition of expert research,which will increase the competitiveness of national forensic systems.

In recent years, as part of the reform of the judicial system in Uzbekistan, the digitization of forensic expertise has been identified as one of the priorities of state policy. This process is implemented through the use of digital technologies in the appointment, conduct, and formalization of expertise results.

The digitization of forensic activities in Uzbekistan is based on the following main regulatory legal acts: the Constitution of the Republic of Uzbekistan [8], the Law "On Forensic Expertise" [9], the Law "On Electronic Government" [10], and the Law "On Informatization" [11], as well as decrees and resolutions of the President of the Republic of Uzbekistan aimed at digitizing the judicial system.

In particular, the Resolution of the President of the Republic of Uzbekistan No. PP-270 dated September 8, 2025

“On measures to further improve forensic activities and widely introduce modern technologies in the field” provides for ensuring the speed, objectivity and completeness of research through the digitization of forensic activities and the use of artificial intelligence technologies, as well as increasing the volume of electronic document exchange in the field to 100 percent through the integration of information systems of forensic organizations and bodies appointing expertise [12]. In this Decision, tasks of establishing electronic information exchange between state bodies are defined.

Currently, the digitalization of forensic activities in Uzbekistan is being implemented step by step. In particular, certain achievements have been achieved in the following areas:

- digitization of the processes of assigning and sending expert opinions . The practice of sending expert opinions in electronic form by investigative and judicial bodies is being introduced. This process will reduce document turnover and save time;
- preparation and archiving of expert opinions in electronic form. Storing expert opinions in digital format

ensures their integrity and security;

- use of special databases. In some types of examination (for example, traceological, ballistic, biological examinations) databases are used for comparative analysis;
- organization of expert activities using information and communication technologies. Remote consultations, electronic reports, and internal information systems are used in the activities of forensic institutions.

At the same time, there are a number of problems in the process of digitizing forensic activities. In particular, not all experts have sufficient qualifications to work with digital technologies. The procedure for using digital tools in certain types of expertise is not clearly regulated.

The next stage of digitization of forensic activities

requires its formation as a systemic, integrated and legally complete mechanism. This process requires not only technical modernization, but also comprehensive reforms in the legal, institutional and personnel training sectors.

It should be emphasized that one of the most important tasks in the digitalization of the forensic science sector is the creation of a single integrated digital information platform. Such a platform should unite judicial, investigative, and forensic institutions in a single electronic space.

for a single platform to perform functions such as electronically scheduling and accepting expertise, electronically sending and receiving expertise materials, confirming expert conclusions with a digital signature, storing expertise results in an electronic archive, and performing statistical analysis and monitoring.

above-mentioned Resolution No. PP-270, an electronic platform "E-expertise" is currently being developed to regulate these relations between the judicial, investigative and expert bodies of our Republic, and a system of integration between all departments and the gradual digitization of document exchange is being introduced by 2026.

In addition, the development of modern information technologies creates the opportunity to introduce elements of artificial intelligence (AI) in forensic activities. In this case, artificial intelligence should be used as an auxiliary tool, without completely replacing expert judgment.

In forensics,it is advisable to use artificial intelligence in important areas such as automatic analysis of large volumes of data, rapid comparison of samples and traces in comparative examinations, reducing the likelihood of examination errors, and detecting repeated examinations [13].

Also, the introduction of artificial intelligence technologies in forensic institutions, in particular, the use of automated evaluation methods in criminalistic analyzes can increase the scientific basis and reliability of expert opinions [14].

In recent years, as in most countries,the number of cybercrimes and their methods of implementation have been increasing in our country. In 2024, cybercrime accounted for 42 percent of all crimes committed.

In the modern era, the complexity of crimes, the increase in the volume of information, and technological progress require new approaches to the field. In particular, various new gadgets and artificial intelligence technologies are rapidly entering all aspects of society, which not only serve to improve people's lives and development, but also lead to the emergence of new types of crimes committed through technology.

For example, in the fields of criminalistics, forensics, financial and computer forensics, digital technologies are increasingly posing threats, especially through Deepfake documents. **Deepfake** are fake photos, videos or audio materials created using artificial intelligence (AI) and deep learning technologies.

In 2024, AI-assisted attacks will increase at an unprecedented rate, with Entrust (an international company specializing in cybersecurity and identity solutions) reporting in its 2025 report that there will be 1 deepfake attack almost every 5 minutes in 2024. has been In 2025 alone, cases of forgery of digital documents will increase by 244 percent compared to the previous year.

This situation, in turn, leads to an increase in the workload of experts working in the field, and in some cases, to objections from judicial and investigative bodies, as this increases the time for considering cases.

The use of artificial intelligence technologies in conducting research in the field of forensic expertise in foreign countries is being gradually introduced.

Also, in our country, opportunities are being created to use the capabilities of artificial intelligence technologies in other areas, in particular, based on the " **SMART SUD** " concept, digitize judicial processes, accelerate electronic document circulation, and justify decisions through artificial intelligence.

The "Strategy for the Development of Artificial Intelligence Technologies until 2030", approved by the Resolution of the President of the Republic of Uzbekistan No. PP-358 dated October 14, 2024, sets as a priority the creation of an appropriate infrastructure by providing state bodies, economic associations, and higher educational institutions with the necessary technical equipment for the practical application of artificial intelligence.

This indicates the need to gradually introduce the use of artificial intelligence technologies in the field of forensic examination in order to further develop the industry and provide close and prompt assistance to the activities of judicial and investigative bodies.

Currently, foreign countries are defining the legal status of artificial intelligence technologies and their application, including the use of forensic and criminalistic research in court and investigative activities.

For your information , the Artificial Intelligence Act (https://ai-act-law.eu/), which establishes harmonised rules on artificial intelligence, was approved by Regulation (EU) No 2024/1689 of the European Parliament and of the Council of 13 June 2024 [15].

Also, in the Republic of Kazakhstan, efforts are being made to establish the legal basis of "Artificial Intelligence".

In order to further improve this direction in our republic, it is appropriate to implement the following measures:

1. Phased introduction of artificial intelligence technologies into the forensic activities of the Republican Center for Forensic Examination named after Kh. Sulaymonova;

2. Develop methodological guidelines and ethical rules for the use of artificial intelligence by forensic experts, based on international experience;

3. Improving the skills of forensic experts and employees in the use of artificial intelligence technologies in conducting investigations.

In addition, one of the most promising areas of application of innovative technologies in the field of forensic examination is the widespread use of 3D modeling.

3D modeling is used to scan a crime scene for subsequent perception through virtual reality. It is used in many foreign countries, including India, Japan, Russia, Belarus, China, Germany, Switzerland, France, Great Britain and the USA, to conduct forensic auto-technical, forensic ballistic, traceological, forensic construction, forensic portrait and forensic medical examinations.

3D modeling allows you to study the objects of expert examinations without damaging them. In particular, within the framework of forensic construction and technical examination, this technology allows you to conduct high-quality expert examinations even in the absence of a project of the object and other technical documentation.

In the digitization of the forensic field, special attention should be paid to the issue of information security. Expertise materials, expert opinions, and personal data are considered confidential information and their protection must be ensured at the legislative level.

In conclusion, it is important to take measures such as cryptographic protection of digital data, the use of electronic signatures and identification systems, strict regulation of access to data, and

the introduction of requirements for the storage of digital evidence in accordance with international standards. In turn, ensuring information security guarantees the reliability and legitimacy of forensic activities.

Creating a single electronic platform for information exchange, increasing the transparency and reliability of expert opinions, and ensuring information security in accordance with international standards will contribute to the fairness and speed of judicial decisions. The reforms being implemented with the participation of a modern material and technical base, sufficient resources, and qualified specialists will allow the forensic system to reach a qualitatively new level, and as a result, further strengthen citizens' trust in the judicial system.

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