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The twenty-sixth collection issue of was prepared in Russian military aggression conditions against Ukraine that did not prevent the Editorial Board from carefully selecting and qualitatively reviewing and editing articles. It includes current materials on criminology, forensic science theory, as well as works on practical issues of various classes, species and subspecies of forensic science.

Our authors are representatives of forensic science institutions, higher education institutions, law enforcement agencies of Ukraine and other countries.

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Contents

EDITOR-IN-CHIEF'S NOTE

Oleksandr Kliuiev. Science in Wartime 5

RESEARCH PAPERS

Nataliia Tkachenko, Viktoria Alexeychuk. Models of the system of forensic science institutions in Ukraine (advantages and risks) 10
Gabrielė Juodkaitė-Granskienė, Mikhail Frolov. Comparative characteristics of bills on forensic science 24
Ivan Yatsenko. Stages of expert research and their application in the forensic veterinary examination of animal carcasses 52
Diana Gaydamakina, Rasa Tamoshiunaite. Research on short manuscripts made by the elderly and old age people 79

RESEARCH PAPERS

Serhii Naumenko, Volodimir Bragnik, Ion Sandu. Features of forensic research on wheeled vehicles with LPG equipment 95
Yuri Pozdnyakov, Igor Bratishko. Challenging issues of performing forensic economic examinations of reports on independent expert valuation of asset value 108
Sergiy Chornyy, Olha Brendel, Davit Gratiashvili. Authenticate images based on their semantic segmentation in deep learning neural networks with their pre-processing with use of filtering methods 125
Volodymyr Ivankov. Principles of forensic economics as a theoretical basis for its conducting 138

SCIENTIFIC NEWS

International support during the war 154

Theory and Practice
of Forensic Science and Criminalistics

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Science in Wartime

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The next issue of the *Theory and Practice of Forensic Science and Criminalistics* collection of scientific papers № 26 was prepared by Editorial Board in the difficult conditions of Russian aggression against Ukraine. This r is special issue! Even when scientists and forensic experts, like all Ukrainians, found themselves in difficult conditions of martial law and the city of Kharkiv, where we are located, suffers from aerial bombardment, artillery shelling and missile strikes from the first day of the war to this day, the Editorial Board accepted and processed author's papers as from Ukraine as from foreign countries. We consider such activity of our partners a powerful message of support and confirmation that developmental sciences are not able to prevent any cataclysms and wars!

We are grateful to the whole world for their assistance in the field of forensic science activity to the institutions of Ukraine and for effective actions to condemn military aggression against the Ukrainian people. Thus, the largest and most influential organization of forensic expert institutions in Europe *ENFSI* excluded Russian institutions from its composition. This fact is a very significant and frank statement of the attitude of a civilized society to the imperial ambitions of Russian uncleanness that dreams of depriving Ukraine and its entire people of Freedom and Independence. No less significant and important for us is the desire of each of the authors of this issue, despite the

This article is translation of the original Ukrainian content, which source is available at the link: *https://khrife-journal.org/index.php/journal* (translation by Andriy Bublikov). The author acknowledges translation as corresponding to the original.

difficult circumstances, to solve issues of forensic science and criminalistics.

Since February 24, the entire Ukrainian nation (in particular, employees of the co-founding institutions of the collection of scientific papers: *Theory and Practice of Forensic Science and Criminalistics*, namely: National Scientific Center «Hon. Prof. M. S. Bokarius Forensic Science Institute» and Yaroslav Mudryi National Law University) feels all the negative consequences of Russian aggression every day. Currently, almost 4,000 houses have been damaged in the city of Kharkiv, where the collection editorial board has been and will continue to be located, most of which are high-rise buildings, industrial and administrative buildings, and other infrastructure. The civilian population is dying every day children, women, elderly people, because the shelling has been going on continuously since the first day of the war. From the very beginning, the Kharkiv military calendar has been dominated by hot days with dozens of explosions. But when the shelling sometimes subsides a bit, Kharkiv residents calm down a bit and hope for the end of the active phase of hostilities. However, over time, the shelling resumed, becoming more frequent, sometimes not giving residents peace of mind for several nights in a row. Our glorious city lives and works in such hell...

However, the hero city of Kharkiv, like other cities and towns, settlements and hamlets located in the zone of active hostilities, adequately holds the defense!

National Scientific Center «Hon. Prof. M. S. Bokarius Forensic Science Institute» has branches in the cities of Mariupol, Kramatorsk and Sievierodonetsk that enemy almost razed to the ground. It also went to the Sumy region, where another branch of our institution is located. Some of our employees have lost their homes as a result of the bombings, and some still live in areas of the city where the enemy is insidiously inflicting artillery and missile strikes. In such difficult circumstances, the first thing, of course, is to save people. It was to save them and their families that the Center leadership directed organizational measures for evacuation at the beginning of the war. For the moment, many of our employees have been evacuated to safer places, some abroad. However, many people work: as at the main office in Kharkiv as remotely (mostly researchers), conduct forensic examinations, participate in site inspections, continue researches and prepare theoretical and research papers for publication in scientific editions.

Due to the difficult conditions of the war, along with the need to save lives, there was a need to provide unique equipment and rarities, which are known to the library and museum funds of the Center. So the most valuable equipment was moved to other regions of the country and the third monument of Mykola Bokarius who is forensic scientist in Europe -was protected with sandbags. Our staff also delivers humanitarian aid to those who need it, defends our Freedom and Independence in the Armed Forces and in territorial defense bodies, participates in charitable events in other words, makes every possible and impossible effort to win.

Due to the challenges of wartime, there was a need to investigate war crimes committed by the aggressor country, so the issue of the appropriate level of forensic science support to justice in wartime became acute that is directly related to improving efficiency of both the scene inspection and subsequent forensic examinations. related to the identification

of the bodies of the dead (forensic DNA analysis) with research on objects seized in demined areas, areas affected by shelling and bombing, solving problematic issues regarding the calculation of material damage and damages caused to legal entities and individuals as a result large-scale damage and destruction of movable and immovable property, non-property damage, as well as expert studies on the consequences of the use of chemical weapons by invaders, specified in the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction, etc.

New challenges and challenges have necessitated the application of the latest methods and approaches in the effective fight against war crimes, in particular, the need for rapid development of a productive system of forensic science support to justice at the stages of pre-trial investigation and further trial. Achieving this goal primarily involves the appropriate material and technical component and safe working conditions of forensic expert during inspection of the scene and while forensic and scientific research.

After all, realities of war require forensic experts and scholars to be even more efficient, even more cohesive in solving forensic tasks and providing forensic science support to justice . Professional periodical Collection of Scientific Papers: *Theory and Practice of Forensic Science and Criminalistics* is one of the cornerstones of such efficiency and cohesion.

The collection editorial board carefully processed all the articles submitted for publication, making every effort to publish a quality product, strictly adhering to international principles and standards. Traditionally, our collection is indexed by *Google Scholar,* international reference databases *ERIH PLUS, Academic Search Engine «RefSeek», Academic Scientific Journals Indexing, Central and Eastern European Online Library (CEEOL), African Quality Centre for Journals, AgEcon, WorldCat, CORE, Index Copernicus International Journal list, Polska Bibliografia Naukova, ResearchBib, Bielefeld Academic Search Engine (BASE), CiteFactor* (which provides indexing of leading international journals and works and provides authors with information on the international impact factor of journals, scientific materials and current scientific events), on the site of the registrar of digital identifiers *DOI*. Full-text online versions of the publication are posted on the Internet on the platforms of *Vernadsky National Library of Ukraine (VNLU*), libraries of forensic institutions of the Ministry of Justice of Ukraine, higher education institutions of the Ministry of Internal Affairs of Ukraine and others. It is worth recalling that collection research papers: *Theory and Practice of Forensic Science and Criminalistics* is published in bilingual issues in Ukrainian and English (distributed among foreign scholars and forensic science institutions, namely: Center partners).

The traditional is also the thematic orientation of the publication - coverage of modern theoretical and applied issues of forensic science, conducting various types of forensic examinations, applying specific expertise in legal proceedings, issues of legal education, training of forensic experts and higher qualification research staff.

The scientific paper collection structure contains two sections: research papers and case notes. The research section opens with the *Models of the System of Forensic Institutions in Ukraine (Advantages and*

Risks), article by ***Natalia Tkachenko***, PhD in Law, Honored Lawyer of Ukraine, and ***Viktoria Alexeychuk***, PhD in Law, Docent drawing attention to the model laid down in the draft of the new Law of Ukraine: *On Forensic Science Activity*. The authors believe that such a model should be very balanced not only in terms of advantages but in terms of the severity of possible negative consequences and risks that may threaten the proper functioning of the forensic industry in general. Important for the process of reforming the system of forensic science institutions is strict compliance with procedural law (giving the parties the opportunity to collect and submit evidence to the court, setting and adhering to procedural deadlines, etc.), as well as appointing a body to form a unified state policy in this area. Researchers consider it expedient to introduce a mixed model of the system of forensic science institutions in Ukraine.

Research paper by ***Gabrielė Juodkaitė-Granskienė***, Doctor of Law, Docent, from Lithuania and ***Mikhail Frolov*** PhD in Law violates the current topics of legislation on forensic expert activities, presenting a comparative review of draft laws submitted to the Verkhovna Rada of Ukraine and registered during the 6th session of the IX convocation, and analyzing the main terminological and material and legal features of the regulation of forensic expert activity, the status of its participants and content. Special attention should be paid to the articles presented by scientists substantiated proposals for the settlement of forensic expert legal relations.

The fundamental work by ***Ivan Yatsenko***, Doctor of Veterinary Medicine, Professor is devoted to the stages of forensic research and their application in the forensic veterinary examination of animal corpses. The stage of such an forensic research reflects not only the procedure for the expert's cognition of properties of forensic veterinary examination objects, but also makes it possible to trace the process of examination and evaluate results obtained while research on expert's conclusion. Each stage of forensic research of animal corpses performs certain functions and ensures solution of intermediate tasks.

The authors of the following article: *Research on short manuscripts made by the elderly and old age people*, ***Diana Gaydamakina***, Leading Forensic Expert of NSC «Hon. Prof. M. S. Bokarius FSI» and ***Rasa Tamoshiunaite*** her colleague from Lithuania, consider theoretical prerequisites for handwriting research on short handwritten records made by elderly and old age people; summarize a significant amount of experimental array and expert practice on the features of research on these handwriting objects; group detected handwriting signs characteristic of the elderly and senile; the algorithm of sequential actions of the expert to solve this issue is revealed in detail.

The *Case Notes* section is opened with research paper by ***Serhii Naumenko,*** PhD in Law, ***Volodimir Bragnik***, Department Head of Sumy Branch of the Center and ***Ion Sandu*** forensic expert from the Republic of Moldova who raise in their article the issues of research by forensic expert of wheeled vehicles with LPG equipment. The authors cite the sequence of actions of the expert in the case of a technical inspection of the wheeled vehicle under research, note the need to take into account availability of gas LPG equipment while determining the market value of the vehicle, as well as the cost of repair and material damage caused to the car owner.

The post by ***Yuri Pozdnyakov*** and ***Igor Bratishko*** concerns the methodological principles of conducting forensic economic examinations of reports on economic measurements performed by methods of independent evaluation of the value of assets. The authors investigated the problematic issues of substantiation of the methodology for quantifying the degree of uncertainty of the evaluation results on the basis of a probabilistic and metrological approach based on the use of an interval form of assessment result presentation and compared the requirements of national and international standards for such an assessment.

In the *Authenticate Images Based on their Semantic Segmentation in Deep Learning Neural Networks with their pre-processing with Use of Filtering Methods* research paper by ***Sergiy Chornyy***, PhD in Technology, Docent, ***Olha Brendel***, Department Head and ***Davit Gratiashvili*** Chief Forensic Expert from Georgia analyzed effectiveness of neural network classifier structures (in particular, convolutive deep learning neural networks) to assess authenticity of images using methods of digital analysis of images, digital painting and artificial intelligence.

The following article *Principles of Forensic Economics as a theoretical basis for its conducting* by ***Volodymyr Ivankov***, PhD in Economics proposes ways to improve forensic economic examination: namely, supplementing it with new stages of conducting (organizational, functional and effective) that will allow to form a theoretical platform for further regulatory regulation of examination procedures for the objects of such forensic examination, namely: accounting and reporting.

The editorial board expresses its sincere gratitude to all the authors who provided content for publication, as well as to the professionals who took part in its edition and invites scholars and practitioners to prepare articles for future issues.

Fruitful interaction of the editorial board and authors is the key to further work on new issues of the *Theory and Practice of Forensic Science and Criminalistics* collection of scientific papers and a guarantee of continuous scientific development even in war conditions.

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Models of the system of forensic science institutions in Ukraine (advantages and risks)

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[a] Methodology, Conceptualization.
[b] Writing — original draft.

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The main models of the system of forensic science institutions are considered, for which there are proposals in the draft of Law On Forensic Science Activity.

This research purpose is to determine the main models of the system of forensic science institutions in Ukraine, as well as analysis of international experience of forensic science support to justice as for implementation of relevant modern world standards in Ukrainian legislation and their application in practice.

The main system models of forensic science institutions are singled out, in particular classical (traditional), neoclassical (updated traditional), radical, mixed (partially radical) and competitive. Integration of Ukrainian system of forensic science support to justice into international community and the entry of domestic forensic science institutions into international organizations uniting foreign forensic science institutions in order to improve procedures for participation of forensic experts in legal proceedings.

Keywords: *models of the system of forensic science institutions; forensic science activity; governance; reforming; classical (traditional) model; neoclassical (updated traditional) model; radical model; mixed (partially radical) and competitive models.*

This article is translation of the original Ukrainian content, which source is available at the link: *https://khrife-journal.org/index.php/journal* (translation by Andriy Bublikov). The author acknowledges translation as corresponding to the original.

Research Problem Formulation

For a long time, the forensic science reform in Ukraine remained virtually out of the attention of the legislature. Some amendments to the current Law of Ukraine: *On Judicial Examination* did not always improve position of forensic experts and satisfy the requests of forensic clients, more often they were discriminatory (in particular, inability to conduct forensic, forensic and forensic psychiatric forensic examinations) criminal proceedings by forensic experts who are not employees of state forensic science institutions) did not fully correspond to the current state of development of forensic science (currently, the Law does not define the status of forensic science institutions (hereinafter referred to as FSI) of non-state forms of ownership, where private forensic experts work that leads to legal conflicts in the case of involving such institutions in providing forensic examinations).

Article purpose

Identification of main models of the system of forensic science institutions in Ukraine, as well as analysis of international experience of forensic science support to justice .

Analysis of Essential Researches and Publications

The scientific basis of the research composed research papers devoted to this issue solving in the field of forensic science including D. Shelton [1], R. T. Bowen [2], H. Wallace, M. A. Pollack, A. R. Young [3], E. Kh. Yukselohlu in collaboration with [4], I. V. Pyrih [5], M. G. Shcherbakovskyi [6], L. M. Romanenko [7] and others.

Some aspects of solving the problems of reforming the basic legislation of Ukraine on expert support of justice are reflected in the works of domestic scholars (in particular, O. M. Kliuiev [8], E. B. Simakova-Yefremian [9],

1 Shelton D. Forensic Science in Court : Challenges in the Twenty First Century. Rowman & Littlefield. Lanham, MD, United States. 196 p.

2 Bowen R. T. Ethics and the Practice of Forensic Science. 2nd Edition. CRC Press, 2021. 272 p.

3 Wallace H., Pollack M. A., Young A. R. Policy-Making in the European Union. 7 ed. Oxford, 2014. 597 p. DOI: 10.1093/hepl/9780199689675.001.0001 (date accessed: 17.03.2022).

4 Юкселоглу Э. Х., Йонар Ф. Ч., Райимоглу, Каратас О., Ашикиоглу Ф. Судебно-экпертное образование в Турции: на примере института судебной медицины. *Актуальні питання судової експертизи та криміналістики* : зб. мат-лів міжнар. наук.-практ. конф., присвяч. 100 річчю від дня народж. д-ра юрид. наук, проф., засл. діяча науки і техніки України М. В. Салтевського (Харків, 07–08.11.2017). Харків, 2017. С. 52—54.

5 Пиріг І. В. Теоретико-прикладні проблеми експертного забезпечення досудового розслідування : монографія. Дніпропетровськ, 2015. 432 с.

6 Щербаковський М. Г. Проведення та використання судових експертиз у кримінальному провадженні : монографія. Харків, 2015. 560 с.

7 Романенко Л. М. Розвиток організації судово-експертної діяльності в Україні з урахуванням досвіду деяких зарубіжних країн. *Право та управління*. 2012. № 1. С. 444–452.

8 Клюєв О. М. Удосконалення експертного забезпечення правосуддя: теоретичні, правові та організаційні аспекти. *Теорія і практика судової експертизи та криміналістики*. 2019. Вип. 19. С. 102–117. DOI: 10.32353/khrife.1.2019.08 (date accessed: 17.03.2022).

9 Сімакова-Єфремян Е. Б. Про необхідність удосконалення законодавства щодо здійснення судово-експертної діяльності в Україні. *Ibid*. С. 118–129. DOI: 10.32353/khrife.1.2019.09 (date accessed: 17.03.2022).

V. Yu. Shepitko [10], V. M. Shevchuk [11], H. K. Avdieieva [12], P. I. Repeshko [13] et al.).

At the same time, the analysis of these and other research papers demonstrates the need to consider models of the system of forensic institutions in order to determine and select the optimal model, laid down in the draft Law on forensic science activity.

Main Content Presentation

Since Ukrainian independence, the issue of reforming the mechanisms of state management of forensic expertise (hereinafter referred to as FEA) has received considerable attention which led to adoption of certain regulations of programmatic and conceptual nature that recognized the need for forensic science as an important and independent institution. bodies conducting inquiries and pre-trial investigations. However, no real action has been taken so far to remove expert services from the bodies of the Ministry of Internal Affairs of Ukraine, Ministry of Defense of Ukraine, Security Service of Ukraine and the State Border Guard Service of Ukraine. These expert services in their activities are forced to be guided by the corporate interests of their ministries and departments, including law enforcement, crime control, crime investigation and more. Under such conditions, the basic principles of FEA are violated: legality, independence, objectivity and completeness of the study that leads to a violation of the rights and legitimate interests of citizens in legal proceedings.

The tasks facing forensic experts in the context of reform require finding and identifying ways to improve the efficiency of state regulation of forensic science activities (FEA), optimization of organizational and regulatory framework, improving mechanisms for state regulation of this activity in Ukraine.

Multidimensionality and scale of this issue determined the need for its comprehensive taking into account multidimensional nature of scientific search.

The modern system of legislative regulation of relations related to forensic examinations is quite complicated. A significant number of legal norms are set out in a large number of acts that a priori cannot but give rise to duplication, contradictions and collisions. The regulatory framework of forensic science activity should be improved not only by updating the forms and methods of conducting examinations but in the direction of maximum consolidation of regulations (it is clear that it is not

10 Шепітько В. Ю. Проблеми нормативно-правового регулювання судово-експертної діяльності в Україні. *Проблеми реформування базового законодавства України з питань експертного забезпечення правосуддя* : мат-ли круглого столу (Харків, 06—07.02.2020). Харків, 2020. С. 25—27.

11 Шевчук В. М. Методологічні проблеми вдосконалення законодавчого забезпечення судово-експертної діяльності. *Ibid*. С. 34—41.

12 Авдєєва Г. Проблеми гармонізації законодавства України у галузі судової експертизи із законодавством країн Європейського Союзу. *Правова доктрина – основа формування правової системи держави* : мат-ли міжнар. наук.-практ. конф., присвяч. 20-річчю НАПрН України та обговоренню п'ятитом. моногр. «Правова доктрина України» (Харків, 20–21.11.2013). Харків, 2013. С. 634—637.

13 Репешко П. І. Щодо сутності судово-експертної діяльності як об'єкта державного регулювання. *Криминалистика и судебная экспертиза*. 2013. Вып. 58 (1). С. 45—52. URL: http://nbuv.gov.ua/UJRN/krise_2013_58%281%29__8 (date accessed: 17.03.2022).

to the detriment of those norms that regulate the specifics of certain types of examinations).

State specialized forensic science institutions of the Ministry of Justice of Ukraine make a leading contribution to conducting forensic examinations, have an extensive system of bodies and highly qualified specialists of various profiles, capable of promptly solving various issues related to the effective implementation of FEA. At the heart of their activities is the territorial principle of service, which ensures timely and optimal conduct of expert research and a multi-stage system of training forensic experts.

Practical issues of public administration of FEA, as rightly noted by S. M. Novikov require their solution by identifying and eliminating various contradictions, inconsistencies, gaps in the organization of expert institutions and in their management, especially since management is one of the system-forming factors of the forensic system[14].

Researching fundamental and applied works in the field *Public Administration* P. I. Nadolishnyi believes that the methodology of public administration can be defined as a set of worldviews and specific knowledge about scientific methods of cognition and change of reality that is philosophical and theoretical basis of research and practice management, purposeful influence of the state on the processes of social development [15]. Development of our state in the direction of democratization of all social relations (in particular, in the field of law enforcement practice and justice) necessitates the improvement of mechanisms of state regulation of the development of FEA, which require radical changes. According to V. V. Lukianenko, FEA management system can be represented as a set of the following interconnected components: the management mechanism (basic principles, functions, goals and methods); control systems in statics (structure of governing bodies, personnel, equipment and technology); management systems in dynamics (management procedure development, adoption and implementation of management decisions); mechanism of self-improvement (as a continuation of functioning and a special stage of dynamics).

According to V. V. Lukianenko, FEA formation of an effective system of public administration in the field can be carried out in the following areas:

1) formation of a new legal framework, which at a higher level will regulate the issues of FEA and its public administration;
2) formation of institutes, organizational structures and tools for public administration that meet the requirements of the present time;
3) staffing of both the state institutions themselves of forensic examinations and the system elements managing them;
4) strengthening and formation of new financial and economic foundations for functioning of state forensic science institutions;
5) scientific and information support of public administration systems in this

14 Новиков С. Н. Организационно-правовые основы экспертно-криминалистической деятельности в органах внутренних дел : дис. ... канд. юрид. наук. Рязань, 2005. С. 6.

15 Надолішний П. І. Фундаментальні і прикладні дослідження в галузі науки «Державне управління». Взаємозв'язок і роль в удосконаленні практики державного управління. *Кримський юридичний вісник*. Сімферополь, 2010. Вип. 2 (9), Ч. II. С. 91.

area, formation of mechanisms for monitoring its functioning [16].

This approach to defining the management system of FEA in Ukraine seems reasonable, because it takes into account the target, functional, organizational and other components of the mechanism of its state regulation in our country. Therefore, FEA as an object of state regulation is the activity of the state, legal entities and individuals to ensure justice by independent, objective, competent and qualified expertise carried out by professional (certified) forensic experts on the basis of the Law of Ukraine: *On Judicial Examination* and others within their competence, in the manner and on the grounds specified by the relevant provisions of current legislation of Ukraine [17].

According to the latest trends in the development of FEA in Ukraine, every year the role of forensic experts is constantly growing not only in solving, investigating and preventing crimes, ensuring evidence in the course of criminal proceedings and proceedings in administrative offenses, the involvement of experts in civil and commercial proceedings [18] is becoming increasingly important and widespread.

However, despite the introduction of a large number of adjustments (primarily those related to the legislative principles of the implementation of FEA and current procedural codes), we can state that the current state of regulatory and legal support for FEA in Ukraine is far from perfect, and the process of reforms initiated by the state in the relevant field is not completed. Most of the issues that theorists in the field of law drew attention to remained unresolved, and the draft Law on Forensic Expert Activity in Ukraine, prepared in 2017 (that, although not in full, but resolves some legislative conflicts), postponed indefinitely. This condition makes scientists to conduct new research on the legislative support of in Ukraine [19].

It should be noted that the legislation regulating the organization and conduct of forensic examination in Ukraine is a significant array of legal norms contained in numerous normative legal acts of different legal forces. The current state of this system can be divided into several levels of normative legal acts:

1) general nature (devoted to the issues of determining the legal status of a forensic expert and forensic examination in Ukraine which apply to all species of forensic examinations);
2) procedural (or sectoral) nature (regulate procedural and procedural issues of appointment and conducting forensic examinations in certain areas of justice);
3) departmental nature (determine the legal status of forensic experts and the peculiarities of their activities in state expert institutions of various departmental affiliations);

16 Лукьяненко В. В. Теоретические основы управления судебно-экспертной деятельностью. *Роль и значение деятельности Р. С. Белкина в становлении современной криминалистики* : мат-лы междунар. науч. конф. (к 80-летию со дня рожд. Р. С. Белкина). Москва, 2002. С. 279.

17 Репешко П. І. Op. cit. С. 50—51. URL: http://nbuv.gov.ua/UJRN/krise_2013_58%281%29__8 (date accessed: 17.03.2022).

18 Гаращук В. М. Проблеми законодавчого забезпечення судово-експертної діяльності в Україні. *Актуальні питання судової експертизи і криміналістики* : зб. мат-лів міжнарод. наук.-практ. конф., присвяченої 150-річчю з дня народження Засл. проф. М. С. Бокаріуса (Харків, 18—19.04.2019). Харків, 2019. С. 41.

19 Ibid.

4) acts devoted to the conduct of various (special) types of forensic examinations [20].

Currently, in Ukraine, no state body is responsible for the formation of a single state policy in the field of FEA that leads to an imbalance of the entire forensic expert system due to the inconsistency of departmental regulatory and legal regulation.

According to Sehai, the issues of its optimization of the organization and infrastructure management, ensuring the practical implementation of legal and methodological foundations, are important in solving the issues of reforming FEA. These issues, according to the researcher, include:

- optimization of organizational forms of management of state forensic science institutions (hereinafter referred to as FSI) and non-state forensic science structures;
- unification of the scientific-methodological and information base of the FSIs, management and coordination of research in the field of forensic science;
- improving methodology and procedures for the certification of professional forensic experts;
- organization of basic training of specialists in the field of FEA of humanitarian and natural-technical profiles;
- improving the methodological and preventive work of the FI optimizing the use of judicial expertise by investigators and courts [21].

Currently, urgency of reforming forensic science has received well-deserved recognition: Verkhovna Rada of Ukraine is considering four draft laws that regulate forensic science activity in Ukraine (№ 6284, 6284-1, 6284-2, 6284-3). One of the main issues where these projects have different approaches is the model of forensic science institutions in Ukraine which is the most reasonable, appropriate and effective. The results of numerous discussions, debates, questionnaires and generalizations between the professional forensic expert community, representatives of pre-trial investigation bodies, courts, advocacy, scientists indicate the ambiguity of their attitude to different models according to which the expert field should operate. survey generalization among the professional community conducted by the Directorate of Legal Policy in the Field of Judiciary, Judiciary and Related Legal Institutions of the Ministry of Justice of Ukraine (Monitoring Report, 2020) demonstrates that majority of respondents (51 %) are in favor of reforming the judicial system), 49 % want to leave the current system of organizational and managerial support, 36 % of respondents say that it is necessary to create a single central executive body to coordinate and control all subjects of forensic expertise, financing their activities in the manner prescribed by law, and 13 % – to introduce a single expert qualification commission.

The analysis of world practice in this matter also indicates the absence of a unified trend in the construction of a system of forensic institutions. In some countries it is the only expert service (for example, in Estonia, Sweden, Norway, Belgium, Portugal, Ireland, Northern Ireland and others - under the Ministry of Justice; in Finland, Slovenia, Slovakia,

20 Ibid. C. 30.

21 Сегай М. Я. Судебная экспертология: объект, предмет, природа и система науки. *Теорія та практика судової експертизи і криміналістики*. 2003. Вип. 3. С. 25—32.

Hungary, Serbia, Croatia and others - under the Ministry of Internal Affairs; in Belarus it is subordinated to the President of the country), in other countries, a system of forensic science institutions with different departmental subordination (for example, in Spain, Poland, Latvia, Lithuania, Moldova, Germany, Romania, Italy, France, etc.).

L. M. Romanenko, researching somewhat related to our issues, it is appropriate to note that when considering the feasibility of the organization of FEA in Ukraine should take into account the positive experience of foreign countries and not ignore the achievements of the domestic model of such activities (including material, methodological , professional opportunities of departmental specialized expert institutions). In an effort to ensure maximum impartiality and independence of forensic examinations, the position of scholars who support the fact that the departmental affiliation of forensic experts is not crucial in their appointment to conduct forensic examinations in administrative proceedings in particular and in administrative proceedings in general deserves support. This is determined by the fact that the agencies must ensure true independence for forensic experts and not influence the conduct of examinations. For this purpose it is necessary to improve the legal regulation of this organizational FEA form and to develop alternative independent forensic expertise, providing equal opportunities in the use of both these forms [22].

Thus, the international experience of expert support of justice is subject to scientific analysis in order to implement the relevant advanced norms in the legislation of Ukraine and apply them in practical activities. This is necessary to improve the procedures for the participation of a forensic expert in the judiciary and the entry of Ukrainian FSI into international organizations that unite various foreign expert institutions in order to integrate the Ukrainian system of forensic science support to justice into international community.

Taking into account the views that exist today, we have tried to identify the main models of the system of forensic institutions, which are proposed in the draft Law on Forensic Science Activity.

I. Classical (traditional) model (currently exists in Ukraine, it is characterized by decentralization in the construction of a system of expert institutions, the functioning of a network of state and municipal expert institutions and services subordinated by the Law to the circle of subjects (ministries and departments), the presence of intra-departmental legal regulation). Varieties: with the restriction of private experts in the right to conduct forensic, forensic and forensic psychiatric examinations; with the provision of private experts with the right to conduct forensic and forensic examinations (with the exception of certain groups of objects).

II. Neoclassical (updated traditional) model (provides, as well as the previous one, decentralization in the construction of a system of expert institutions, the functioning of the current network of state and municipal expert institutions and services with the possibility of creating new expert institutions by an unlimited range of entities (ministries and departments), the presence of intra-departmental legal regulation). Today, initiatives to create its own departmental expert service have, for example, the State Bureau of Investigation.

III. Radical model (new for Ukraine, it provides for centralization through the creation of a single Central Executive

22 Романенко Л. М. Op. cit. С. 450—451.

Body: State Expert Service, subordinate to the Cabinet or the Ministry of Justice of Ukraine, which will ensure the implementation of state policy in the field of justice and subordinate all departmental state and non-state experts institutions and private forensic experts with whom it will conclude agreements on the provision of forensic services and pay for them, as well as ensure the work of the Central Expert Qualification Commission to assign (deprive) qualifications of forensic experts bring them to disciplinary responsibility, control over the organization their activities; ensuring the maintenance of Registers of certified forensic experts and methods of forensic examinations; organization of research in the field of forensic examination and regulatory and methodological support of forensic experts).

IV. Mixed (partially radical) model (contains a classical or neoclassical model for the existence of an extensive system of departmental expert institutions with elements of centralization - the definition of the Ministry of Justice of Ukraine as the only body that forms state policy in the forensic expert field, as well as the introduction of unified qualification and disciplinary bodies (commissions) under the Ministry of Justice, which will equally include representatives of various agencies that are subordinated to the Ministry of Justice, expert institutions, as well as representatives of the private sector of forensic experts).

V. Competitive model (based on decentralization of extensive system of departmental forensic institutions with such a feature that forensic science institutions subordinate to agencies with pre-trial investigation functions provide only the needs of relevant pre-trial investigation bodies in conducting forensic examinations, involving specialists in investigative actions). Each of the bodies (agencies) with such functions should have its own expert service, in contrast, expert institutions and experts who are not subordinate to such agencies (namely, forensic science institutions of the Ministry of Justice of Ukraine, Ministry of Healthcare of Ukraine, non-state expert institutions and private experts), provide expert services on the appointment of the court and at the request of other persons (bodies) in any of proceedings (defense expert, defense conclusion, alternative forensic examination, forensic re-examination)).

Advantages, disadvantages and risks of each model are formed in the form of a comparative table (see Table 1).

Table 1

Comparison of models of the system of forensic science institutions

Models	Classical	Neoclassical	Radical	Mixed	Competitive
Advantages:					
• competitiveness of experts from different departments, that contributes to the quality of forensic examinations;	+	+	–	+	+

Models	Classical	Neoclassical	Radical	Mixed	Competitive
• availability of an alternative in the subject choice of forensic examinations for customer;	+	+	–	+	+ (except for pre-trial investi-gation bodies)
• determination of the legal status of non-state expert institutions;	–	+	+	+	+
• elimination of discrimination against other bodies in formation of forensic science institutions;	–	+	–	–/+	+
• elimination of the risks of violation of forensic expert independence by the heads of forensic science institutions and departments through the transfer of their functions to assign (deprive) qualification of a forensic expert, implementation of disciplinary proceedings is uniform for all experts to qualification and disciplinary commissions with a single procedure for their work and a fairly defined composition;	–	–	+	+	–
• delimitation of the body that should form a single state policy in the field of forensic science and bodies implementing this policy;	–	–	+	+	–
• unified professional requirements while acquiring forensic expert status;	–	–	+	+	–
• uniform qualification and disciplinary bodies for all forensic experts with a single procedure for their work;	–	–	+	+	–
• procedure unification for conducting examinations;	–	–	+	+	–
• ensuring equality between state and non-state forensic experts (in capabilities of professional training, advanced training, access to examinations of various types, grounds for bringing to justice, etc.);	–	–	+	+	–
• unified criteria of remuneration;	–	–	+	–	–
• optimization of the number of state forensic science institutions, staffing number of employees taking into account the workload by type of forensic examinations or regions;	–	–	+	–	–

Models	Classical	Neoclassical	Radical	Mixed	Competitive
• reducing the financial costs of the state regarding maintenance of forensic science institutions that do not have sufficient workload;	–	–	+	–	–
• ensuring uniformity of the load on experts (in particular, by introducing an electronic distribution of forensic examinations);	–	–	+	–	–
• possibility of increasing the amount of salaries of state forensic experts by optimizing forensic science institutions;	–	–	+	–	–
• uniformity of material, technical and personnel support of forensic science institutions;	–	–	+	–	–
• elimination of corruption intra-departmental risks (in particular, the bias of forensic medical examinations in cases of indictment bias, where health care providers are a party that is possible in the case of conducting forensic examinations at forensic science institution of the same department where pre-trial investigation is carried out);	–	–	+	–	–
• unification of methods of forensic examinations (both generally recognized by the scientific and expert community and tested in practice);	–	–	+	–	–
• centralized procedure of organization and control over the implementation of research works taking into account the needs of practice (in particular, on a competitive basis);	–	–	+	–	–
• convenience of monitoring the activities of subjects of forensic expert activity according to the unified criteria	–	–	+	–	–
Disadvantages and risks:					
• inconsistency of proposed system of forensic science institutions with the results of reforming law enforcement agencies and newly created central executive bodies (creation of the Bureau of Economic Security, reform of Security Service of Ukraine);	+	–	–	+	–

Models	Classical	Neoclassical	Radical	Mixed	Competitive
• needs for additional financial costs from the state budget;	–	+	+	–	+
• risk of usurpation of forensic examination by a single monopoly state body;	–	–	+	–	–
• negative impact on the procedure of forensic examinations during the reform, formation, reorganization or liquidation of forensic science institutions, registration of new legal relations, formation of the body (institution) apparatus, inhibition indefinitely;	–	–	+	–	–
• political opposition of agencies that are subordinated to forensic science institutions;	–	–/+	+	–/+	+
• lack of qualified forensic expert staff from the full list of types of forensic examinations necessary for the body	–	–	–	–	+

Conclusion

Selection of the model laid down in the draft Law on Forensic Expert Activity, should be very balanced not only in terms of benefits but in severity of negative consequences and risks that can occur, jeopardizing proper functioning of the forensic expert industry in general for a long time. It is important in reforming the system of forensic science institutions to comply with procedural legislation (possibility of collecting and submitting evidence by the parties to the court, taking into account procedural terms, etc.), as well as determining the body responsible for formation of a single state policy in this area.

Taking into account the above, a mixed model of the system of forensic science institutions can be considered more expedient for implementation in Ukraine.

Моделі системи інституцій судової експертизи в Україні (переваги та ризики)

Наталія Ткаченко, Вікторія Алєксейчук

Розглянуто основні моделі системи інституцій судової експертизи, щодо яких є пропозиції в проєкті закону про судово-експертну діяльність.

Метою дослідження є визначення основних моделей системи інституцій судової експертизи в Україні, а також аналіз міжнародного досвіду експертного забезпечення правосуддя у справі імплементації

відповідних сучасних світових норм у законодавство України і застосування їх у практичній діяльності.

Виокремлено основні моделі системи інституцій судової експертизи, зокрема класичну (традиційну), неокласичну (оновлену традиційну), радикальну, змішану (частково радикальну) та змагальну. Обґрунтовано інтеграцію української системи експертного забезпечення правосуддя в міжнародний простір і вступ вітчизняних судово-експертних установ до міжнародних організацій, якими об'єднано зарубіжні експертні інституції, із метою вдосконалення процедур участі судових експертів у судочинстві.

Ключові слова: *моделі системи інституцій судової експертизи; судово-експертна діяльність; державне управління; реформування; класична (традиційна) модель; неокласична (оновлена традиційна) модель; радикальна модель; змішана (частково радикальна) і змагальна моделі.*

Модели системы институций судебной экспертизы в Украине (преимущества и риски)

Наталья Ткаченко, Виктория Алексейчук

Рассмотрены основные модели систем институций судебной экспертизы, по которым существуют предложения внедрения в проекте закона Украины о судебно-экспертной деятельности.

Целью исследования является определение основных моделей системы институций судебной экспертизы в Украине, а также анализ международного опыта экспертного обеспечения правосудия в деле имплементации соответствующих современных мировых норм в законодательство Украины и применение их в практической деятельности.

Выделены основные модели системы институций судебной экспертизы, в том числе классическую (традиционную), неоклассическую (обновлённую традиционную), радикальную, смешанную (частично радикальную) и соревновательную. Обоснована интеграция украинской системы экспертного обеспечения правосудия в международное пространство и вступление отечественных судебно-экспертных учреждений в международные организации, объединяющие зарубежные экспертные институции, с целью совершенствования процедур участия судебных экспертов в судопроизводстве.

Ключевые слова: *модели систем институций судебной экспертизы; судебно-экспертная деятельность; государственное управление; реформирование; классическая (традиционная) модель; неоклассическая (обновлённая традиционная) модель; радикальная модель; смешанная (частично радикальная) и соревновательная модели.*

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Declaration of Competing Interest

The authors declare that they have no conflict of interest.

References

Avdieieva, H. (2013). Problemy harmonizatsii zakonodavstva Ukrainy u haluzi sudovoi ekspertyzy iz zakonodavstvom krain Yevropeiskoho Soiuzu [Issues of legislation harmonization of Ukraine in the field of forensic science with legislation of

European Union]. *Pravova doktryna — osnova formuvannia pravovoi systemy derzhavy* : mat-ly mizhnar. nauk.-prakt. konf., prysviach. 20-richchiu NAPrN Ukrainy ta obhovorenniu piatytom. monohr. «Pravova doktryna Ukrainy» (Kharkiv, 20–21.11.2013). Kharkiv [in Ukrainian].

Bowen, R. T. (2021). *Ethics and the Practice of Forensic Science.* 2nd Edition. CRC Press.

Harashchuk, V. M. (2019). Problemy zakonodavchoho zabezpechennia sudovo-ekspertnoi diialnosti v Ukraini [Issues of legislative support of forensic science activity in Ukraine]. *Aktualni pytannia sudovoi ekspertyzy i kryminalistyky* : zb. mat-liv mizhnarod. nauk.-prakt. konf., prysviachenoi 150-richchiu z dnia narodzhennia Zasl. prof. M. S. Bokariusa (Kharkiv, 18—19.04.2019). Kharkiv [in Ukrainian].

Iukseloglu, Eh. Kh., Ionar, F. Ch., Raiimoglu, Karatas O., Ashikioglu F. (2017). Sudebno-ehkpertnoe obrazovanie v Turtsii: na primere instituta sudebnoi meditsiny [Forensic education in Turkey: on the example of Institute of Forensic Medicine]. *Aktualni pytannia sudovoi ekspertyzy ta kryminalistyky* : zb. mat-liv mizhnar. nauk.-prakt. konf., prysviach. 100 richchiu vid dnia narodzh. d-ra yuryd. nauk, prof., zasl. diiacha nauky i tekhniky Ukrainy M. V. Saltevskoho (Kharkiv, 07–08.11.2017). Kharkiv [in Russian].

Kliuiev, O. M. (2019). Udoskonalennia ekspertnoho zabezpechennia pravosuddia: teoretychni, pravovi ta orhanizatsiini aspekty [Improvement of forensic support: theoretical, legal and organizational aspects]. *Teoriia i praktyka sudovoi ekspertyzy ta kryminalistyky.* Vyp. 19. DOI: 10.32353/khrife.1.2019.08 [in Ukrainian].

Lukianenko, V. V. (2002). Teoreticheskie osnovy upravleniia sudebno-ehkspertnoi deiatelnostiu [Theoretical foundations of forensic science activity management]. *Rol i znachenie deiatelnosti R. S. Belkina v stanovlenii sovremennoi kriminalistiki* : mat-ly mezhdunar. nauch. konf. (k 80-letiiu so dnia rozhd. R. S. Belkina). Moskva [in Russian].

Nadolishnyi, P. I. (2010). Fundamentalni i prykladni doslidzhennia v haluzi nauky «Derzhavne upravlinnia». Vzaiemozviazok i rol v udoskonalenni praktyky derzhavnoho upravlinnia [Basic and applied research in the field of Public Administration. Relationship and role in improving public administration practice]. *Krymskyi yurydychnyi visnyk.* Vyp. 2 (9). Ch. II [in Ukrainian].

Novikov, S. N. (2005). *Organizatsionno-pravovye osnovy ehkspertno-kriminalisticheskoi deiatelnosti v organakh vnutrennikh del* [Organizational and legal foundations of forensic activities in the internal affairs bodies] : dis. ... kand. iurid. nauk. Riazan [in Russian].

Pyrih, I. V. (2015). *Teoretyko-prykladni problemy ekspertnoho zabezpechennia dosudovoho rozsliduvannia* [Theoretical and applied issues of forensic science support to pre-trial investigation] : monohrafiia. Dnipropetrovsk [in Ukrainian].

Repeshko, P. I. (2013). Shchodo sutnosti sudovo-ekspertnoi diialnosti yak obiekta derzhavnoho rehuliuvannia [On essence of forensic science activity as an object of state regulation]. *Kriminalistika i sudebnaia ehkspertiza.* Vyp. 58 (1). URL: http://nbuv.gov.ua/UJRN/krise_2013_58%281%29__8 [in Ukrainian].

Romanenko, L. M. (2012). Rozvytok orhanizatsii sudovo-ekspertnoi diialnosti v Ukraini z urakhuvanniam dosvidu deiakykh zarubizhnykh krain [Development of organization of forensic science activities in Ukraine taking into account experience of some foreign countries]. *Pravo ta upravlinnia.* № 1 [in Ukrainian].

Segai, M. Ia. (2003). Sudebnaia ehkspertologiia: obieekt, predmet, priroda i sistema nauki [Forensic Expertology: Object, Subject, Nature and System of Science]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 3 [in Russian].

Shcherbakovskyi, M. H. (2015). *Provedennia ta vykorystannia sudovykh ekspertyz u kryminalnomu provadzhenni* [Conducting and using forensic examinations in criminal proceedings] : monohrafiia. Kharkiv [in Ukrainian].

Shelton, D. *Forensic Science in Court : Challenges in the Twenty First Century.* Rowman & Littlefield. Lanham, MD, United States.

Shepitko, V. Yu. (2020). Problemy normatyvno-pravovoho rehuliuvannia sudovo-ekspertnoi diialnosti v Ukraini [Issues of normative-legal regulation of forensic science activity in Ukraine]. *Problemy reformuvannia bazovoho zakonodavstva Ukrainy z pytan ekspertnoho zabezpechennia pravosuddia* : mat-ly kruhloho stolu (Kharkiv, 06—07.02.2020). Kharkiv [in Ukrainian].

Shevchuk, V. M. (2020). Metodolohichni problemy vdoskonalennia zakonodavchoho zabezpechennia sudovo-ekspertnoi diialnosti [Methodological issues of improving the legislative support of forensic science activities]. *Problemy reformuvannia bazovoho zakonodavstva Ukrainy z pytan ekspertnoho zabezpechennia pravosuddia* : mat-ly kruhloho stolu (Kharkiv, 06—07.2020). Kharkiv [in Ukrainian].

Simakova-Yefremian, E. B. (2019). Pro neobkhidnist udoskonalennia zakonodavstva shchodo zdiisnennia sudovo-ekspertnoi diialnosti v Ukraini [On the need for improvement of legislation regarding implementation of forensic science activities in Ukraine]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky.* Vyp. 19. DOI: 10.32353/khrife.1.2019.09 [in Ukrainian].

Wallace, H., Pollack, M. A., Young, A. R. (2014). *Policy-Making in the European Union.* 7 ed. Oxford, 2014. 597 p. DOI: 10.1093/hepl/9780199689675.001.0001.

Tkachenko, N., Alexeychuk, V. (2022). Models of the system of forensic science institutions in Ukraine (advantages and risks). *Theory and Practice of Forensic Science and Criminalistics.* Issue 1 (26). P. 10—23. DOI: 10.32353/khrife.1.2022.02.

Comparative characteristics of bills on forensic science

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Since adoption of the Law of Ukraine: On Judicial Examination in 1994, the provision of justice by forensic experts has changed significantly, there is an urgent need to update regulations governing the issue of forensic science. That is why the deputies of the 6th session of the IX convocation as subjects of the legislative initiative submitted to the Verkhovna Rada of Ukraine a number of bills on the reform of judicial expertise in our country, a comparative review of which is presented here. The main terminological and legal features of the regulation of forensic activity, its content and status of its participants are also considered. The main criteria of reform and directions of development of the legislation on forensic activity abroad are singled out. A brief overview of the historical development of the legislation on forensic expertise in Ukraine is given. The main ways of forming definitions in the normative regulation of forensic activity and its subjects are outlined. Substantiated proposals for the settlement of forensic legal relations are provided. It is proposed to eliminate the identified shortcomings of the bills. The purpose of the article is based on a comparative analysis of regulations on judicial reform submitted to the Verkhovna Rada of Ukraine during September 2021 – January 2022 (6th session of the IX convocation) by the subjects of legislative initiative, and taking into account the current state scientific discussion, to formulate practically sound

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proposals to determine the optimal construction in Ukraine of the system and structure of institutions and officials who have the right to carry out forensic science activity.

Keywords: *forensic expert; forensic examination; legislative regulation of forensic expert activity; subjects of forensic expert activity; draft normative acts on forensic expert activity.*

Research Problem Formulation

One of forensic expert independence guarantees and correctness of his conclusion (paragraph 5 of Article 4 of the Law of Ukraine: On Judicial Examination [1], hereinafter referred to as core Law) is creation of necessary conditions for forensic expert. Since the core Law adoption in 1994 (despite numerous amendments and additions to it), provision of justice by forensic experts has evolved (changed the sources of funding for such activities, departmental affiliation of forensic institutions, etc.), there is an urgent need to reform regulations of forensic science activity.

In addition, forensic expert does not function separately from the system of bodies and officials involved in the field of forensic science, so comprehensive reform of these legal relations has become particularly relevant when considering bills on the basic principles of forensic science in Ukraine. Solving the issues raised by the authors of this article is not only theoretical but applied one.

Analysis of Essential Researches and Publications

Some issues of reforming normative acts on forensic science activity of the last twenty years were considered: H. Avdieieva, L. Holovchenko, V. Vasyliev, O. Kliuiev, D. Kurylenko, O. Naranovych, I. Ovsiannykova, S. Onopriienko, A. Polianskyi, E. Popovich, E. Simakova-Yefremian, O. Snigerov, I. Spasenko, H. Strilets, V. Shepitko, M. Shcherbakovskyi, G. Juodkaitė-Granskienė, V. Yurchyshyn and others. [2]

1 Про судову експертизу : Закон України від 25.02.1994 р. № 4038-XII (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/4038-12#Text (date accessed: 04.03.2021).

2 Клюєв О. М. До питання міжнародного співробітництва в галузі судової експертизи. *Теорія та практика судової експертизи і криміналістики.* 2018. Вип. 18. С. 154—162. DOI: 10.32353/khrife.2.2018.17 (date accessed: 12.02.2022) ; Снігерьов О. П., Андренко С. О. До питання з визначення поняття судової експертизи в адміністративному провадженні (*оглядова стаття*). *Ibid.* С. 231—240. DOI: 10.32353/khrife.2018.25 (date accessed: 12.02.2022) ; Попович Є. М. Принципи організації та функціонування автоматизованих ситем у судово-експертній діяльності. *Ibid.* С. 248—256. DOI: 10.32353/khrife.2018.27 (date accessed: 12.02.2022) ; Шепітько М. В. Проблеми виявлення та розслідування злочинів проти правосуддя, що вчиняються професійними учасниками судочинства (провадження). *Ibid.* 2019. Вип. 19. С. 48—57. DOI: 10.32353/khrife.1.2019.04 (date accessed: 12.02.2022) ; Клюєв О. М.

Article purpose

This article purpose is on the basis of a detailed comparative analysis of legal acts on judicial reform submitted to the Verkhovna Rada of Ukraine during September 2021— January 2022 (6th session of the IX convocation) by the subjects of the legislative initiative (people's deputies and the Cabinet of Ministers of Ukraine) and taking into account the current state of the scientific discussion — to formulate practical proposals for determining the optimal construction in Ukraine of the system and structure of institutions and officials authorized to carry out forensic science activity.

Main Content Presentation

At the present stage of state-building, among other important tasks, it is relevant to confidently direct Ukraine towards integration into the European Union (in particular, by adapting as lawsuit in general as out-of-court proceedings (criminal, executive, etc. [3]), in particular, for example, in terms of organization, appointment,

Удосконалення експертного забезпечення правосуддя: теоретичні, правові та організаційні аспекти. *Ibid.* С. 102—117. DOI: 10.32353/khrife.1.2019.08 (date accessed: 12.02.2022) ; Сімакова-Єфремян Е. Б. Про необхідність удосконалення законодавства щодо здійснення судово-експертної діяльності в Україні. *Ibid.* С. 118—129. DOI: 10.32353/khrife.1.2019.09 (date accessed: 12.02.2022) ; Щербаковський М. Г., Куриленко Д. В. Обізнані особи в судочинстві України (*оглядова стаття*). *Ibid.* С. 142—157. DOI: 10.32353/khrife.1.2019.011 (date accessed: 12.02.2022) ; Попович Є. М. Єдність науки та практики в судово-експертній діяльності. *Ibid.* С. 158—172. DOI: 10.32353/khrife.1.2019.012 (date accessed: 12.02.2022) ; Шепітько В. Ю., Авдєєва Г. К. Проблеми застосування науково-технічних засобів та інноваційних продуктів у діяльності органів правопорядку. *Ibid.* 2019. Вип. 20. С. 11—26. DOI: 10.32353/khrife.2.2019.01 (date accessed: 12.02.2022) ; Сімакова-Єфремян Е. Б. До питання про введення у кримінальне процесуальне законодавство поняття «висновок спеціаліста». *Ibid.* С. 110—120. DOI: 10.32353/khrife.2.2019.07 (date accessed: 12.02.2022) ; Онопрієнко С. А., Наранович О. В., Спасенко І. О. Щодо питання проведення міжлабораторних порівнянь під час судово-експертної діяльності. *Ibid.* С. 162—174. DOI: 10.32353/khrife.2.2019.12 (date accessed: 12.02.2022) ; Овсянникова І. М. Основні засади визначення ефективності судово-експертної діяльності: адміністративно-правовий аспект. *Ibid.* С. 215—229. DOI: 10.32353/khrife.2.2019.16 (date accessed: 12.02.2022) ; Васильєв В. М. Судова експертиза у цивільному та господарському провадженні як окрема форма застосування спеціальних знань. *Ibid.* 2020. Вип. 21. С. 120—132. DOI: 10.32353/khrife.1.2020.08 (date accessed: 12.02.2022) ; Щербаковський М. Г. Співвідношення та структура криміналістичної техніки й судової експертології. *Ibid.* С. 133—147. DOI: 10.32353/khrife.1.2020.09 (date accessed: 12.02.2022) ; Пиріг І. В. Інформаційне забезпечення експертної діяльності. *Ibid.* С. 179—193. DOI: 10.32353/khrife.1.2020.12 (date accessed: 12.02.2022) ; Овсянникова І. М. Судово-експертна діяльність як об'єкт адміністративно-правового регулювання. *Ibid.* С. 267—280. DOI: 10.32353/khrife.1.2020.17 (date accessed: 12.02.2022) ; Шепітько В. Ю. Формування криміналістики та криміналістичної дидактики в Україні. *Ibid.* Вип. 22. С. 7—19. DOI: 10.32353/khrife.2.2020.01 (date accessed: 12.02.2022) ; Полянський А. О., Юодкайтє-Ґранскієнє Ґ. Щодо класифікації завдань загальної теорії судової експертизи і практичної судово-експертної діяльності (*оглядова стаття*). *Ibid.* С. 179—192. DOI: 10.32353/khrife.2.2020.13 (date accessed: 12.02.2022).

3 Про Загальнодержавну програму адаптації законодавства України до законодавства Європейського Союзу: Закон України від 18.03.2004 р. № 1629-IV (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/1629-15#Text (date accessed: 12.02.2022).

execution and registration of studies that require specific expertise in various fields of science, technology, art or other spheres of human activity).

In 1994, Ukraine was the first of the post-Soviet countries to adopt a specialized Law on Forensic Examination [4]. However, since then, 28 years have passed, which to some extent detracted the profile Law from the realities of the present, and also radical changes in the economic model of Ukraine and the reception of EU legislation have led to the scientific relevance of the problem, which faced not only lawmakers and legal scientists [5], but also practical experts of the forensic expert community, the need for regulatory regulation of social relations that were objectively formed during this time both in the field of forensic examination in particular, and while organizing activities for conducting forensic research in general [6].

Ukrainian scientists emphasized immediate updating of national legislation taking into account the best practices of the European Union back in 2010s [7].

At the same time, only in 2019, the authorities recognized the need for a draft law on the creation of a system of self-government of forensic experts, the introduction of a review of the conclusion of a forensic expert and the definition of deadlines for conducting forensic examinations (as provided for in paragraph 4 of sub-paragraph "b" of paragraph 3 of Art. 1 of the Decree of the President of Ukraine No. 837/2019: *On urgent measures to implement reforms and strengthen the state dated on November* 8, 2019 [8] in terms of implementing measures in the areas of legal policy, ensuring human and civil rights and freedoms).

Only in 2020, the rights holder approached implementation of conditions for regulatory regulation of self-government of forensic experts and expanding access of persons to the services of forensic experts as a component of access to justice (in particular, by balancing the powers of private and state forensic experts and promoting competition between them) in accordance with the Program of Activities of the Cabinet of Ministers of Ukraine,

4 Про судову експертизу : ... . URL: http://zakon.rada.gov.ua/cgibin/laws/main.cgi?nreg=4038-12 (date accessed: 20.09.2021).

5 Клюєв О. М. Реформування базового законодавства України з питань експертного забезпечення правосуддя — нагальна потреба часу. *Проблеми реформування базового законодавства України з питань експертного забезпечення правосуддя* : мат-ли кругл. столу (Харків, 06—07.02.2020). Харків, 2020. С. 6—11. URL: https://www.hniise.gov.ua/user_files/File/other/13%20%D0%BF%D0%BE%D1%81%D0%BB%D0%B5%D0%B4%D0%BD%D1%8F%D1%8F%20%D0%BD%D0%B0%20%D0%BF%D0%B5%D1%87%D0%B0%D1%82%D1%8C.pdf (date accessed: 12.02.2022).

6 Клюєв О. М. Міжнародне наукове співробітництво — ефективний механізм удосконалення судово-експертної діяльності. *Актуальні питання судової експертизи і криміналістики* : зб. мат-лів міжнар. наук.-практ. конф.-полілогу (Харків, 15—16.04.2021). Харків, 2021. С. 37. URL: https://www.hniise.gov.ua/uploads/files/public-folder/2021_tezy_konference%20in%20print5.pdf (date accessed: 12.02.2022).

7 E.g.: Сімакова-Єфремян Е. Б. До питання про взаємозалежність європейських інтеграційних процесів і тенденцій інтеграції спеціальних знань в Україні. *Теорія та практика судової експертизи і криміналістики* : зб. наук. пр. 2017. Вип. 17. С. 152—158. DOI: 10.32353/khrife.2017.18 (date accessed: 19.11.2021).

8 Про невідкладні заходи з проведення реформ та зміцнення держави : Указ Президента України від 08.11.2019 р. № 837/2019. URL: https://www.president.gov.ua/documents/8372019-30389 (date accessed: 20.02.2022).

approved by the Resolution of the Cabinet of Ministers of Ukraine dated June 12, 2020 No. 471[9]: The Government of Ukraine saw fit to integrate expert institutions into the newly created judicial system as integral part [10].

In addition, in pursuance of the provisions of the Decrees of the President of Ukraine dated on 30.09.2019 № 722/2019 *On the Sustainable Development Goals of Ukraine until 2030* [11] and on 08.11.2019 № 837/2019 *On urgent measures to carry out reforms and strengthening of the state* [12] scientific and practical measures were taken, as a result of which 4 bills on forensic examination and forensic expertise were prepared and adopted for consideration, namely: 1) the bill on forensic science (dated 05.11.2021 № 6284 the subject of the right of legislative initiative: the Cabinet of Ministers of Ukraine, hereinafter referred to as the bill *6284*) [13]; 2) bill on forensic science (dated on 19.11.2021 № 6284-1; the subject of the right of legislative initiative: the People's Deputy of Ukraine; hereinafter referred to as the bill *6284-1*) [14]; 3) bill on forensic science activity and Self-Government of forensic experts (dated on November 22, 2021 № 6284-2; the subject of the right of legislative initiative: the People's Deputy of Ukraine; hereinafter referred to as the bill *6284-2*) [15]; 4) the bill on Amendments to the Law of Ukraine: *On Judicial Examination* (dated on November 22, 2021 № 6284-3; the subject of the right of legislative initiative: the People's Deputy of Ukraine; hereinafter referred to as the bill *6284-3*) [16].

Therefore, after the formulation of the essence of the legal problem of this study, it is advisable to determine its epistemological basis. We share the opinion that the study of the mechanism for the implementation of the rule of law in legal terms contributes to a deep disclosure of the nature of the law, the legal understanding of reality [17].

9 Програма діяльності Кабінету Міністрів України [Activity program of the cabinet of ministers of Ukraine]: затв. Постановою КМУ від 12.06.2020 р. № 471. URL: https://zakon.rada.gov.ua/laws/file/text/81/f495727n7.pdf (date accessed: 20.02.2022).

10 Банчук О. Схвалений Урядом законопроєкт про судово-експертну діяльність дозволить вирішити головні проблеми у цій сфері / Новини Міністерства. 03-11-2021 // Офіц. сайт Мін'юсту України. URL: https://minjust.gov.ua/news/ministry/oleksandr-banchuk-shvaleniy-uryadom-zakonoproekt-pro-sudovo-ekspertnu-diyalnist-dozvolit-virishiti-golovni-problemi-u-tsiy-sferi (date accessed: 12.02.2022).

11 Про Цілі сталого розвитку України на період до 2030 року : Указ Президента України від 30.09.2019 р. № 722/2019. URL: https://www.president.gov.ua/documents/7222019-29825 (date accessed: 12.02.2022).

12 Про невідкладні заходи з проведення реформ та зміцнення держави : Указ Президента України від 08.11.2019 р. № 837/2019. URL: https://www.president.gov.ua/documents/8372019-30389 (date accessed: 20.02.2022).

13 Проєкт Закону про судово-експертну діяльність від 05.11.2021 р. № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

14 Проєкт Закону про судово-експертну діяльність від 19.11.2021 р. № 6284-1. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

15 Проєкт Закону про судово-експертну діяльність та самоврядування судових експертів від 22.11.2021 р. № 6284-2. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73258 (date accessed: 12.02.2022).

16 Проєкт Закону про внесення змін до Закону України «Про судову експертизу» від 22.11.2021 р. № 6284-3. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73261 (date accessed: 12.02.2022).

17 Халфина Р. О. Общее учение о правоотношении : монография. Москва, 1974. С. 6.

It is a well-known statement: "Only with the emergence of the legal profession is the nature of the systematic presentation of legal norms understood, their constructive connection is realized, and science develops legal constructions that become an important reference point, a method of learning law. Based on the achievements of science, the legislator begins to consciously use legal constructions as a means of constructing normative material. Then the normative constructions and the constructions of legal science go hand in hand, enriching each other. Legal science not only comprehends the constructions that are expressed in law. Analyzing these constructions, it identifies their shortcomings, makes proposals to improve them, as well as develops new constructions that more adequately reflect the legal relations, better meet the interests of the state at a certain stage of society. The use of perfect legal constructions by the legislator, in turn, leads to the improvement of legislation" [18].

In addition, the ontological, that is, the value aspect (in terms of values as the main ideas to be protected and protected by legal means) of a comprehensive study of the problems of regulating forensic expert activity under the drafts of new regulatory legal acts also deserves attention. An act of law (in a broad sense) acquires an objective meaning at the time of its occurrence[19]. It is possible and expedient to analyze the legislation primarily through the study of objective factors that accompany or condition the occurrence of a specific legal phenomenon, in this case, normalization of forensic science activity.

We can conclude that as of nowadays, the legislation on forensic science (both at the ontological and practical levels) does not fully reflect the objective reality: formation of a new Ukrainian statehood and the formation of appropriate legal matter due, in particular, to the implementation of the rules of law of the European Union. The purpose of the adaptation of *the domestic law to the EU acguis communautaire* is the accession of Ukraine to the European Union — subject to the requirements imposed by the EU on states intending to join it [20].

In addition, the subjects of the legislative initiative have identified problematic aspects that require improvement, namely: legislative consolidation of the conceptual apparatus of forensic expert activity in order to ensure a unified approach to their use in law enforcement activities (*expert initiative, forensic expert qualification, methodology for conducting forensic examination, forensic science activity*, etc.) and the basic principles of forensic expert activity; more clearly defining the status, rights and obligations of forensic experts, forensic expert institutions and their heads.

The issue of disciplinary responsibility of forensic experts (determination of the range of such acts and their responsibility) needs urgent solution at the legislative level.

Analytical part of our study considers it expedient to start with definition of the main predicate: forensic examination: a multi-digit concept that in practical terms means forensic science activity, in scientific: field of knowledge, in procedural one: source of evidence, in evidence: means of proof, in epistemological one: a special

18 Черданцев А. Ф. Юридические конструкции, их роль в науке и практике. *Известия вузов. Правоведение*. 1972. № 3. С. 12—19.

19 Ibid. С. 14.

20 Грицак С. В. Адаптація інформаційного законодавства України до норм Європейського Союзу : автореф. дис. … канд. юрид. наук. Запоріжжя, 2013. 16 с.

type of research, in law enforcement: procedure and results of the specific expertise application [21].

At the level of scientific abstraction, the above definition is seen as complete, at the same time (given the high level of scientific generalization), it is difficult to apply such a definition in normative technology to create a modern legislative act on forensic examination and forensic science activity that meets the purpose of government standard-setting, aspirations of scientists and the expectations of practitioners. At the legislative level, the following definitions are proposed:

- forensic examination is research by the subject of forensic examination on the basis of specific expertise in accordance with legislation of material (materialized) objects that contain information about facts and circumstances that are relevant to the case (proceedings) or are of interest to the customer of forensic examination (the bill: 6284 [22]);
- forensic research is a process of cognitive activity of a forensic expert in order to establish on the basis of specific expertise on factual data and circumstances of proceedings in any type of proceedings, outside the proceedings in cases provided for by law and enforcement proceedings (the bill: 6284-1 [23]);
- forensic examination is a research by an expert on the basis of specific expertise in the field of science, technology, art, craft, etc. of tangible and intangible (information) objects, phenomena and processes that contain information about the actual data and circumstances of the case that are or will be the subject of legal proceedings and through the subject of such examination (the bill 6284-2 [24]);
- forensic examination is a research based on specific expertise in the field of science, technology, art, craft, etc., objects, phenomena and processes in order to provide an opinion on issues that are or will be the hearing subject (the bill: 6284-3 [25]).

In our opinion, the most successful is the formulation of the concept of *forensic examination* in the bill 6284 implemented at the suggestion of E. B. Simakova-Yefremian [26].

At the same time, consciously or involuntarily but at the legislative level, several draft legislative acts were adopted for consideration, in which the concept of *forensic examination* was applied. This state does not promote certainty both in

21 Щербаковський М. Г. Проведення та використання судових експертиз у кримінальному провадженні : монографія. Харків, 2015. 560 с.

22 Проєкт Закону ... № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

23 Проєкт Закону ... № 6284-1. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

24 Проєкт Закону ... № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

25 Проєкт Закону ... № 6284-3. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

26 Сімакова-Єфремян Е. Б. До питання про необхідність внесення змін до статті 1 Закону України про судову експертизу. *Судова експертиза: сучасність та майбутнє* : мат-ли кругл. столу (Львів, 25—26.01.2019) ; за заг. ред. д-ра техн. наук. М. О. Кузіна. Львів, 2019. С. 124.

the legal system and within individual legal and procedural institutions.

We consider it advisable to additionally dwell on special knowledge as a component of the competence of the subject of forensic examination. Current legislation (Laws of Ukraine dated on 04.07.2014 No. 1590-VII *On Amendments to Certain Laws of Ukraine on Certain Issues of Medical and Social Expertise* [27], dated on 24.05.2012, № 4845-VI On Amendments to the Law of Ukraine *On Energy Saving* on Payment for State Expertise on Energy Saving" [28], dated 17.06.2004 No. 1808-IV "On State Expertise of Land Management Documentation" [29], dated 10.02.1995 № 51/95-ВР *On Scientific and Scientific Technical Expertise*" [30], dated on 09.02.1995 № 45/95-ВР *On Ecological Examination*, etc.) [31] and the above draft laws contain (contained) provisions on the need to apply specific expertise while conducting forensic researches.

Thus, the established definitions of *forensic expert* and *forensic examination*", although they do not reflect the entire essence of the formed legal phenomenon, make it possible to distinguish a group of persons who conduct research that require the specific expertise application in various fields and for whose activities the legislation is being updated.

Perhaps (for the purpose of further species definition), it is advisable to pay additional attention to the fact that the subjects mentioned in the above-mentioned laws of Ukraine conduct research but not in a manner or on the grounds stipulated by the core Law and the above-mentioned draft laws on this issue[32].

Scientific discussions have already taken place on [33], but unanimous recommendations on the names of persons whose activities are currently regulated by the core Law and other subjects of forensic research have not yet been finalized. Although the authors of the bill 6284 proposed to change some articles of the procedural codes of Ukraine (to separate a forensic expert from specialist, rename the expert in law to a legal adviser), namely:

27 Про внесення змін до деяких законів України щодо окремих питань проведення медико-соціальної експертизи : Закон України від 04.07.2014 р. № 1590-VII. URL: https://zakon.rada.gov.ua/laws/show/1590-18#Text (date accessed: 12.02.2022).

28 Про внесення змін до Закону України «Про енергозбереження» щодо оплати державної експертизи з енергозбереження : Закон України від 24.05.2012 р. № 4845-VI. URL: https://zakon.rada.gov.ua/laws/show/4845-17#Text (date accessed: 12.02.2022).

29 Про державну експертизу землевпорядної документації: Закон України від 17.06.2004 р. № 1808-IV (утрат. чин.). URL: https://zakon.rada.gov.ua/laws/show/1808-15#Text (date accessed: 12.02.2022).

30 Про наукову і науково-технічну експертизу : Закон України від 10.02.1995 р. № 51/95-ВР (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/51/95-%D0%B2%D1%80#Text (date accessed: 12.02.2022).

31 Про екологічну експертизу : Закон України від 09.02.1995 р. № 45/95-ВР (утрат. чин.). URL: https://zakon.rada.gov.ua/laws/show/45/95-%D0%B2%D1%80#Text (date accessed: 12.02.2022).

32 Шепітько В. Ю. Проблеми нормативно-правового регулювання судово-експертної діяльності в Україні. *Проблеми реформування базового законодавства України з питань експертного забезпечення правосуддя* : мат-ли кругл. столу (Харків, 06—07.02.2020). Харків, 2020. С. 26.

33 Угровецький О. П., Свідерський О. О. Напрямки формування сучасного теоретичного підґрунтя судово-експертної діяльності в Україні. *Судова експертиза: сучасність та майбутнє* : мат-ли кругл. столу (Львів, 25—26.01.2019) ; за заг. ред. д-ра техн. наук. М. О. Кузіна. Львів, 2019. С. 135.

Art. 70 of the Commercial Procedural Code of Ukraine[34] Art. 73 of the Civil Procedural Code of Ukraine[35], Art. 69 of the Code of Code of Administrative Proceedings of Ukraine because now and Art. 70 of the Code of Civil Procedure of Ukraine [36] and Art. 73 Commercial and Procedural Code of Ukraine and Art. 69 Code of Administrative Proceedings of Ukraine of Ukraine are called: *Expert in Law*.

We see this approach as appropriate: *firstly*, according to Part 2 of Art. 102 of the Civil Procedural Code of Ukraine, the subject of the expert's conclusion cannot be legal issues (therefore, within the framework of one normative act (Civil Procedural Code of Ukraine), there are contradictions that do not describe the legal phenomenon of forensic examination on the merits), *secondly*, the definition of *legal consultant* is not consistent with terminology of the Criminal Procedure Code of Ukraine [37] in terms of the name of the participant in the process who possesses specific expertise and skills and *"can provide advice, explanations, references and conclusions during the pre-trial investigation and trial on issues requiring relevant specific expertise and skills"* (Part 1 of Art. 71 of the Criminal Procedure Code of Ukraine) [38].

To unify the procedural terminology and prevent misinterpretation or complications of judicial practice, we propose to use in the current legislation and draft regulations the name of the participant in the process who is involved in the case to provide advice on legal issues: *specialist (professional) on legal issues*.

Perhaps, the differentiation of these persons and the relevant legal institutions needs some refinement in view of the conceptual place of the subjects of expert research in the judiciary, so we suggest using the designations: *forensic expert* and *forensic examination* to distinguish the subjects of forensic examination from the rest of the experts whose activities are not subject to regulation by the relevant Law as persons providing expert conclusion in the sense of the draft Law 6284 and do not belong to the circle of persons whose activities are planned to be regulated in the event of the entry into force of one of the above-mentioned bills.

The concepts of *forensic expert* and *forensic examination* are conditioned by a certain form of both the appointment of an examination and its conduct. Since one of the guarantees of effective protection of the rights and freedoms of citizens is the establishment and observance of the procedural form, and the judicial form is the most regulated (its violation causes negative consequences for both the judge and the parties to the process), so the availability of the *forensic* word in the subject designation conducting such research, and in the designation of the activity carried out by him can indicate that this activity (and therefore the qualification of forensic expert) meets the requirements of the procedural form, its results are

34 Господарський процесуальний кодекс України від 06.11.1991 р. № 1798-XII (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/1798-12#Text (date accessed: 12.02.2022).

35 Цивільний процесуальний кодекс України від 18.03.2004 р. № 1618-IV (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/1618-15#Text (date accessed: 12.02.2022).

36 Кодекс адміністративного судочинства України від 06.07.2005 р. № 2747-IV (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/2747-15#Text (date accessed: 12.02.2022).

37 Кримінальний процесуальний кодекс України від 13.04.2012 р. № 4651-VI (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/4651-17#Text (date accessed: 12.02.2022).

38 Ibid.

allowed to be used in the trial as a means of proof.

Accordingly, the concept of *forensic examination* can be used only in unconditional connection with the subject performing such research: a forensic expert. The bill 6284 uses the phrase *forensic expert* 42 times, in particular, in Art. 15 *Forensic expert*: *"1. The forensic expert carries out activities on conducting forensic examinations on a professional basis. A forensic expert may be a citizen of Ukraine who has a second-level higher education in the relevant field of knowledge, has received professional training, received a qualification of a forensic expert in accordance with this Law, and the information about which is included in the Register of Forensic Experts* [39].

Such an addition corresponds to the current trends of scientific substantiation of the theory of forensic research, in particular, to the praxeological approach to determining the nature of the activity of a forensic expert, because *"forensic expert activity is carried out by an expert — a knowledgeable person endowed with special knowledge. The coloring of "special" is not in the very knowledge, but in the person who is trained."* [40]

The bill 6284-1 in Art. 24 proposes a slightly different definition of the status of the subject of forensic examination, namely: forensic expert:

"1. Forensic expert may be a person who has an educational and qualification level not lower than a master's degree in a certain specialization or in a certain field of knowledge has scientific, technical or other special knowledge, has qualification of a forensic expert and has received the right to conduct a forensic examination in a certain expert specialty, in accordance with the procedure established by this Law.

2. State forensic experts may be persons who meet the requirements of part 1 of this article and the qualification requirements established by state bodies, whose sphere of management includes state specialized forensic expert institutions, have received appropriate training in a state specialized forensic expert institution or in a subject of educational activity and have passed a qualification examination for the right to conduct a forensic examination in a certain forensic specialization in the manner prescribed by this Law.

3. Private forensic experts may be persons who meet the requirements of Part 1 of this Article and the qualification requirements established by state bodies, the management of which includes state specialized forensic expert institutions, trained (internship): according to the program of training a forensic expert in theoretical , organizational and procedural issues of forensic science at the Institute of Law and Postgraduate Education of the Ministry of Justice of Ukraine or the state research institution of forensic examinations, which have the appropriate license to carry out educational activities in the field of advanced training; according to the programs of training a forensic expert in the relevant expert specialties in the state specialized forensic expert institution and passed the qualification exam for the right to conduct a forensic examination in a certain expert specialization, in the manner prescribed by this Law" [41].

We believe that the concept of determining the legal personality of

39 Проєкт Закону ... № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

40 Каминский М. К. Специальные знания — сила? *Криміналіст першодрукований*. 2011. № 3. С. 71.

41 Проєкт Закону ... № 6284-1. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

a forensic expert proposed by the authors of the bill: 6284-1 contains provisions that need to be improved. *Firstly*, clause 1 of this article does not meet the requirements of the legislation on higher education (for example, it does not take into account standard of educational qualification, according to which the master's degree was issued). *Secondly*, the dichotomy: *public — private* clauses 2 and 3 regarding the status of a forensic expert is not very successful, since it concerns the forensic expert's belonging to the public or private sector: in our opinion, this is unacceptable.

If a dichotomy at the legislative level is necessary, we propose to distinguish forensic experts depending on the place of work (for example: a forensic expert of a public or private expert institution or private practice) and to refuse to distinguish such persons by belonging to a certain institution, leaving, if necessary, a difference in the substantive criterion, that is, according to the range of expert studies that are authorized to be performed by forensic experts.

The bill: 6284-2 [42] also does not define the subjectivity of forensic expert due to the praxeological aspect of his activities, instead it makes requirements for the status of a forensic expert. In other words, a forensic expert may be a person who has acquired this status, but does not carry out such activities. Such a definition also has certain disadvantages at the level of generalization of the legal phenomenon.

The bill: 6284-3 actually proposes to state in a different wording the current specialized Law: in particular, removing from Art. 10 the requirements for the qualification of an expert, as well as information about the very fact of the professional activity of a forensic expert[43].

Taking into account the normative definition of the legal personality of the forensic expert, we consider the designs of draft laws 6284 and 6284-1 to be the most successful; they correspond to modern scientific and practical recommendations and tasks of regulatory regulation (taking into account our proposed clarification).

At the same time, given the need to distinguish between forensic experts and private forensic experts, it should be noted that the bill: 6284, despite most of the positive aspects, still has some shortcomings in the normative definition of legal personality of a forensic expert. For example, in Art. 14 defines the list of persons - subjects of forensic examination, which include forensic experts and other persons - specialists in the relevant field of knowledge, involved in forensic examinations in the absence of a forensic expert in this field or involved in a comprehensive or commission examination. This definition seems quite reasonable, while Art. 55 of the bill: 6284 requires requirements for the opinion — but not of a forensic expert, but of an ordinary expert that does not correspond to the concept of updating the legislation providing for examination only by forensic experts.

Therefore (to develop the provision on the peculiarities of the subjective status of a forensic expert), we propose to apply the *expert's conclusion* phrase (in the sense of Art. 55 of the draft Law 6284) to an exceptional forensic expert (in order to prevent divergent interpretations of this norm by the parties in controversy).

42 Проєкт Закону … № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

43 Проєкт Закону … № 6284-3. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

The next element of the comparative research on scientific and practical significance of the draft laws on forensic expert activity is the definition of the essence of forensic expert activity and the methods of such determination in the relevant draft laws, so we should briefly outline the state of the scientific discussion on this issue and the main aspects that require regulatory settlement.

According to H. O. Strilets, *"forensic expert activity is the activity of forensic expert institutions regulated by law, aimed at conducting independent forensic examinations by means of objective, comprehensive and complete research in compliance with modern achievements of science and technology, organization of the work of forensic expert institutions in general and their structural units, their scientific, methodological and information support, selection and training of forensic expert personnel"* [44].

M. Ya. Sehai identifies four structural blocks that make up an integral system of forensic expert activity (hereinafter referred to as *FEA*):

"1) activities of the state on legal support of the FEA at the legislative and departmental normative and legal levels;
2) activities of state executive bodies, which carry out the function of managing FEA;
3) activities of the main FEA entities that ensure organizing and conducting forensic examinations in state FSI;
4) activity of participants in proceedings involved in the conducting forensic examinations. [45]

In this regard, according to M. Ya. Sehai, *"forensic expert activity as an object of knowledge of forensic expertise can be defined as the activity of the state, legal entities and individuals to provide justice with an independent, objective and qualified examination carried out by professional (certified) forensic experts. <…> The legal basis of forensic expert activity corresponds to the law enforcement function of forensic expertology and an independent section of its cognitive structure, which reveals the "legal field" of FEA as a system of its regulatory framework and legal relations of its participants"* [46].

It is also believed that forensic expert activity should not be limited to specialized forensic science institutions, although most of the examinations are carried out in them: that is, both employees of forensic expert institutions and knowledgeable persons, for whom conducting forensic examination is not mandatory can be involved in conducting forensic examinations [47].

Summing up the state of scientific discussion on the issue raised, we note that forensic expert activity should be considered not from the standpoint of the organization of the work of the forensic expert or the rest of investigation participants, but from the standpoint of the cognitive and practical activities of the forensic expert.

Draft Law 6284 in paragraph 12 of Art. 1 defines that *"forensic science activity is a systemic activity carried out by the subjects defined by this Law, related to organizing, conducting forensic examinations, their*

44 Стрілець Г. О. Генезис системи судово-експертних установ в Україні та напрямки їх діяльності : автореф. дис. … канд. юрид. наук. Київ, 2009. С. 14.

45 Сегай М. Я. Судебная экспертология: объект, предмет, природа и система науки. *Теорія та практика судової експертизи і криміналістики*. 2003. Вип. 3. С. 28—32.

46 Ibid. С. 29.

47 Аленин Ю. П. и др. Уголовно-процессуальный кодекс Украины : науч.-практ. коммент. / под общ. ред. В. Т. Маляренко, Ю. П. Аленина. Харьков, 2005. С. 479.

scientific and methodological, information and staffing" [48].

At the same time, the rest of the draft laws contain formulations of forensic science activity, different from those set out in the bill: 6284.

Thus, clause 20 of Art. 1 of the bill 6284-1 states: *"Forensic expert activity is a special type of activity related to the organization and conduct of forensic examinations, expert research aimed at providing authorized persons (bodies), legal entities and individuals with independent, qualified and objective conclusions focused on the maximum use of the achievements of science and technology, the creation and improvement of the scientific and methodological base in the field of forensic science and forensic examination, as well as public administration and local government in this field."* [49] Art. 3 of the bill: 6284-1 *Content of forensic science activity* states:

"1. Forensic science activity

1) *conducting forensic examination*
2) *conducting forensic researches in order to provide opinions outside the proceedings;*
3) *scientific research related to creation of a theoretical basis and methods for conducting forensic examinations (planning, conducting scientific works, approbation and implementation of their results in expert practice);*
4) *scientific, methodological and information support in the field of forensic science;*
5) *organizational and managerial support in the field of forensic science;*
6) *selection, professional training and advanced training of forensic experts;*
7) *training of scientific personnel of higher qualification for the purpose of expert provision of justice"* [50].

In our opinion, such a list of activities contributes to the certainty and regularity of forensic expert activity for several reasons: *first* (and most importantly), content of such activity is the conducting forensic examinations (as determined by the scientists whose theses are mentioned above) and remaining elements are closely related to this; *secondly*, expansion of the list of types of forensic expert activity contributes to an effective settlement at both the normative and practical levels.

For its part, the draft Law 6284-2 proposes to define forensic expert activity as *"activity of the state, legal entities and individuals in order to provide justice in Ukraine with an independent, qualified and objective examination focused on the maximum use of the achievements of science, technology, art and crafts"* (clause 19 of Art. 1) [51], and discloses forensic expert activity components:

"1) conducting forensic examination

2) *conducting research and generalizations in the field of forensic science (planning, conducting, approbation of scientific works and implementation of their results in expert practice);*
3) *scientific, methodological and information support;*
4) *organizational and managerial support*
5) *selection, training and procedures for the provision, promotion and in-service training of forensic experts (para. 1 of Art.3)* [52].

48 Проєкт Закону … № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

49 Проєкт Закону … № 6284-1. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

50 Ibid.

51 Проєкт Закону … № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

52 Ibid.

We can also agree with the above, since the definition of the subject uses the *justice* term for its ensuring such activities are carried out. At the same time, justice in Ukraine is an exclusively monopoly right of the state. Justice is carried out by state-authorized officials: judges who, in accordance with the procedure established by law, decide on the conduct of the examination. Forensic examination provides justice in Ukraine, as it is a separate source of evidence, which, by the way, are used in almost every trial (in addition, the examination has the right to appoint and conduct under non-judicial proceedings).

The bill: 6284-3 in general avoids the normative definition of forensic expert activity, noting only what is forensic examination and what are the principles of its implementation: *""forensic expert activity is carried out on the principles of legality, independence, objectivity and completeness of research"* [53]. This approach to determining the essence of forensic expert activity is not considered reasonable: *firstly*, due to the fact that the draft law 6284-3 itself is not a comprehensive normative act designed to regulate social relations at a new level; *secondly*, it does not distinguish the characteristic and essential features of the activity planned for settlement.

Based on the definitions of forensic expert activity of the bills: 6284 and 6284-1, we propose to amend paragraph 12 of Art. 1 of draft Law 6284 to read as follows: *"12) forensic expert activity is a systemic activity* ***for conducting forensic expert studies, provided by authorized state bodies and officials by providing organizational, scientific, methodological, information and other services,*** carried out by the *subjects defined by this Law, related to the organization, conduct of forensic examinations, their scientific, methodological, information* ***and*** *personnel support"* [Emphasis added.— ***Ed.***], supplementing with elements of the FEA, given in Art. 3 of the bill: 6284-1[54].

The next element of our deconstruction is a system of bodies, institutions and persons conducting forensic science activity and whose legal relations are supposed to be regulated by adoption of one of the analyzed bills.

According to the current version of Part 1 of Art. 7 of the relevant Law, *"forensic expert activity is carried out by state specialized institutions, <...> as well as forensic experts who are not employees of these institutions, and other specialists (experts) from the relevant fields of knowledge <...>"* [55]. Forensic science activity related to forensic, forensic medical and forensic psychiatric examinations is carried out exclusively by state specialized institutions[56].

Therefore, it can be argued that in the regulation of forensic expert activity in Ukraine, the legislator prefers state specialized institutions that constitute a single system including:

- "forensic science institutions of the Ministry of Justice of Ukraine;
- forensic science institutions, forensic medial and forensic psychiatric institutions of the Ministry of Healthcare of Ukraine;
- *expert services of the Ministry of Internal Affairs of Ukraine, Ministry*

53 Проєкт Закону ... № 6284-3. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

54 Проєкт Закону ... № 6284-1. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

55 Про судову експертизу : ... . URL: http://zakon.rada.gov.ua/cgibin/laws/main.cgi?nreg=4038-12 (date accessed: 20.09.2021).

56 Ibid ; Халфина Р. О. Op. cit.

of Defense of Ukraine, Security Service of Ukraine , State Border Guard Service of Ukraine" [57].

In the Republic of Moldova, there is a similar system of public forensic science institutions to Ukraine including specialized institutions of the Ministry of Justice and the Ministry of Healthcare, operational technical and forensic and forensic units of the Ministry of Internal Affairs and the National Center for Combating Corruption. In addition, the state may form other public forensic institutions [58].

As we can see from the materials of scientific discussion, determining the optimal structure and system of institutions and persons authorized for forensic science activity is an important task of legislative support of such activity (E.g.,: L. M. Holovchenko, G. O. Strilets, A. A. Manzhula [59]).

Conceptual vision of the system of persons authorized to conduct forensic examination indicates that eventually all bodies and institutions of forensic examination of departmental and national subordination, are more likely to be concentrated under the leadership of the Ministry of Justice of Ukraine. At the same time, expert scientists note that today in the world there is a tendency to ensure the independence of the expert, focusing not on his departmental affiliation, but on the availability of specialist special knowledge necessary to solve of justice issues; introduction of competition of experts involved by various parties in the proceedings, obtain a truly independent, objective and qualified forensic examination [60].

Therefore, in order to optimize budget expenditures, it makes sense to conduct additional research as organizational as financial and economic nature on feasibility of a branched structure of departmental forensic science institutions (perhaps more appropriate to form a single scientific and practical forensic institutions on the basis of existing as leaders in the system of forensic science in Ukraine taking into account international best practices).

World organizing practice of forensic science activity and its management knows various approaches to building a system of bodies conducting forensic research. A meaningful research on this issue is set out in 2015 in a scientific and practical review [61].

57 Про судову експертизу : Закон України ... . URL: https://zakon.rada.gov.ua/laws/show/4038-12#Text (date accessed: 20.02.2022) ; Овсянникова І. М. Організація діяльності судово-експертних установ в Україні як складна система. *Судова експертиза: сучасність та майбутнє* : мат-ли кругл. столу (Львів, 25—26.01.2019) ; за заг. ред. д-ра техн. наук. М. О. Кузіна. Львів, 2019. С. 98.

58 Катарага О., Петкович П. Система судебной экспертизы в республике Молдова. Проблематика. *Ibid.* С. 62—63.

59 Головченко Л. Н. Реформирование системы экспертного обеспечения правосудия в Украине. *Теорія та практика судової експертизи і криміналістики* : мат-ли міжнар. наук.-практ. конф. (Харків, 19—20.06.2002). 2002. Вип. 2. С. 5—9 ; Стрілець Г. О. Op. cit. 16 с. ; Манжула А. А. Проблеми організації діяльності науково-дослідних установ в Україні : монографія. Харків, 2015. 468 с.

60 Авдєєва Г. К. Проблеми гармонізації законодавства України у галузі судової експертизи із законодавством країн Європейського Союзу. *Актуальні питання досудового розслідування та сучасні тенденції розвитку криміналістики* : мат-ли міжнар. наук.-практ. конф. (Харків, 05.12.2014). Харків, 2014. С. 335.

61 Любченко С. О., Нізовцев Ю. Ю., Парфило О. А. Система забезпечення судово-експертної діяльності в державах — членах НАТО : наук.-практ. огляд / за заг. ред. О. А. Парфило. Київ, 2015. 56 с.

Currently, sectoral affiliation of some expert institutions in Ukraine looks like this. The largest in terms of number and tasks is the Expert Service of the Ministry of Internal Affairs of Ukraine, which includes the State Scientific Research Forensic Center (SSRFC) of the Ministry of Internal Affairs of Ukraine of the Ministry of Internal Affairs of Ukraine, the main institution of this Service, which providing organizational and managerial Territorial Research Forensic Centers (hereinafter referred to as SRFC) stationed in the regions of Ukraine [62].

The next group of subjects of forensic science activity is the state specialized forensic science and forensic psychiatric institutions of the Ministry of Health of Ukraine. The network of forensic medical institutions consists of the Main Bureau of Forensic Medical Examination of the Ministry of Healthcare, Bureau of Forensic Medical Examination of Health Departments of Regional State Administrations. The regional bureaus also include city (cities of regional subordination) and district (inter-district) branches [63].

The system of forensic science institutions of the Security Service of Ukraine includes: Expert Forensic Service of the Central Office of the Security Service of Ukraine and forensic groups in regional bodies [64].

The analysis of the receipts of tasks to the SBU expert institutions shows a significant increase in recent requests for technical (computer-technical, phonoscopic, ballistic, explosive), chemical and linguistic examinations. For example, in 2014 (compared to 2012) the number of explosive studies increased: 9 times, photo portraits: 8.5 times, linguistic and ballistic: 5 times, phonoscopic: 2.3 times. At the same time, during the same period, the number of studies of special technical means of covert information decreased: 5 times, handwriting: 3 times, cold steel: 2 times, drugs by 40 %, technical examination of documents by 20 % [65].

One of the main tasks of the expert subdivisions of the State Border Guard Service is to conduct forensic examinations of passport documents when crossing the state border of Ukraine. Such examinations became especially relevant after the annexation of Crimea and the occupation of part of the Donetsk and Luhansk regions and the introduction in 2017 of a visa-free regime with the European Union and other countries [66].

Thus, today the expert services structurally belong to four ministries and a state body of special purpose with law enforcement functions, the Security Service of Ukraine, contrary to the conceptual vision of the system of forensic institutions within the judiciary.

However, neither the current relevant Law nor the draft laws on forensic science we have studied offer a modern definition of the system of forensic expert institutions that hinders regulation of legal relations in this area.

62 Міністерство внутрішніх справ України / Офіц. сайт. URL: https://mvs.gov.ua/ (date accessed: 12.02.2022).

63 Ibid. URL: https://mvs.gov.ua/ (date accessed: 12.02.2022).

64 Служба безпеки України/ Офіц. сайт. URL: https://ssu.gov.ua/ (date accessed: 12.02.2022).

65 Некраха Д. О., Охріменко О. І. Стан та перспективи експертних досліджень в СБУ, окремі проблемні питання. *Криминалистика и судебная экспертиза.* 2015. Вип. 60. С. 49. URL: https://kndise.gov.ua/activity/metodics (date accessed: 12.02.2022).

66 Міністерство внутрішніх справ України ... . URL: https://mvs.gov.ua/ (date accessed: 12.02.2022).

The next element of comparative legal research of draft regulations on judicial and expert activities is the notions of subjects of forensic science activity proposed by lawmakers. Let's take a look at the scientific discussion surrounding this issue. According to one opinion, the range of subjects of expert research should not go beyond performance of expert research and therefore belonging to the circle of subjects of anyone other than the experts themselves is inappropriate [67]. The second opinion is a broader and more comprehensive approach to the definition of subjects of forensic expertise and the expansion of such activities beyond the actual expert research [68]. The third group of scholars argues that the existence of forensic institutions in the list of subjects of expert activity is inexpedient given depersonalization of legal liability of legal entities (in particular, in the case of deliberately false opinion or refusal to provide conclusion) [69].

Draft regulations on this issue (as well as on many others) do not contain a single opinion on the definition of persons who are subjects of forensic expertise. At the same time, Bills 6284 and 6284-1 most successfully outline all participants in forensic activities and further distinguish between participants in forensic activities of the subjects of forensic examination, proposing to legally determine the content of forensic activities in seven areas of various interconnected activities.

This approach of lawmakers seems quite appropriate, especially compared to other proposals for regulatory regulation of these issues in projects 6284-2 [70] and 6283-3 [71].

The content of forensic expert activity is defined somewhat differently in the draft Law 6284-2: in addition to the list of types of such activity, in Art. 3 components of its content are also called scientific and methodological, informational and organizational and managerial support, *"selection, training and procedures for providing, improving and disqualifying forensic experts"* [72].

The bill: 6284-3 generally avoids the normative definition of the content of forensic expertise, although it sets out its principles in Art. 3, as well as several times mentions the means of providing forensic expertise in Art. 8 [73].

67 Чорноус Ю. М., Лопата О. А. Поняття та завдання судово-експертної діяльності у сучасних реаліях. *Криміналістика і судова експертиза*. 2016. Вип. 61. С. 6. URL: https://nbuv.gov.ua/UJRN/krise_2016_61_3 (date accessed: 12.02.2022).

68 Сімакова-Єфремян Е. Б. Теоретико-правові та методологічні засади комплексних судово-експертних досліджень : автореф. дис. … д-ра юрид. наук. Харків, 2017. С. 24 ; Дудич А. В. Експерт як учасник кримінального провадження : автореф. дис. … канд. юрид. наук. Одеса, 2017. С. 8.

69 Головченко Л. М. Змістовна роль науково-практичних коментарів до Закону України «Про судову експертизу». *Актуальні питання судової експертизи та криміналістики* : зб. мат-лів засід. «кругл. столу», присвяч. 85-річ. створ. ХНДІСЕ ім. Засл. проф. М. С. Бокаріуса (Харків, 11—12.11.2008). Харків, 2008. С. 19.

70 Проєкт Закону … № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

71 Проєкт Закону … № 6284-3. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

72 Проєкт Закону … № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

73 Проєкт Закону … № 6284-3. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

We propose to consider the requirements for acquisition, suspension and termination of the status of a forensic expert, proposed by bills 6284, 6284-1, 6284-2, 6284-3.

Art. 15 of the bill: 6284 stipulates that *"forensic expert may be a citizen of Ukraine who has a second level of higher education with a master's degree in the relevant field of knowledge, professional training, qualified as a forensic expert in accordance with this Law, and information about which is entered in the Register of Forensic experts"* [74].

Art. 24 of the bill: 6284-1 stipulates that " *forensic expert may be a person who has an educational qualification level not lower than a master's degree in a certain specialty or in a certain field of knowledge, has scientific, technical or other special knowledge, qualifies as a forensic expert and has the right conducting forensic examination in a certain expert specialty, in the manner prescribed by this Law*" [75].

Art. 19 of the bill: 6284-2 stipulates: "*forensic expert who carries out forensic activities on a professional basis may be a person who has a complete higher education in the relevant field of knowledge, has undergone appropriate training, passed a qualifying examination, sworn a forensic expert, received digital signature with a certificate of qualification of a forensic expert in a certain specialization and included in the State Register of Certified Forensic Experts of Ukraine*" [76], that terminologically does not meet the requirements of current legislation.

The wording of Art. 10: *Persons who may be forensic experts* of the draft Law 6284-3 also do not comply with the provisions of current legislation in terms of determining the level of higher education as a qualification requirement for obtaining the status of a forensic expert[77]. In addition, the whole meaning of the normative regulation of this status is nullified if those who want to acquire such a status have obtained higher education outside of Ukraine. Given that some universities do not train specialists in some specialties, a hypothetical situation is quite possible: when a diploma of higher education abroad does not meet the requirements of current domestic legislation on higher education or the provisions of the above draft laws on the status of forensic expert.

As the compared bills provide for forensic examinations only to persons who have the appropriate permission granted by the authorized state body for attestation of forensic experts, the requirements for the education of a forensic expert are not considered appropriate because in criminology there is already a criterion for determining / lack of forensic expert's ability to conduct certain examinations – competencies [78].

74 Проєкт Закону ... № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

75 Проєкт Закону ... № 6284-1. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

76 Проєкт Закону ... № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

77 Проєкт Закону ... № 6284-3. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

78 Ковалевська Є. В. Процесуальні та кваліфікаційні вимоги до правосуб'єктності спеціаліста-медика та судового експерта, які беруть участь у кримінальному провадженні. *Юридичний часопис Національної академії внутрішніх справ.* 2017. № 2 (14). С. 267—280. URL: https://elar.naiau.kiev.ua/jspui/handle/123456789/5186 (date accessed: 12.02.2022) ; Антонюк П. Є. Щодо професійної компетентності судово-медичного

Thus, imperative requirement of the mentioned bills for the education of an expert will make it impossible, in particular, to involve persons who have studied abroad (or will complicate the examination in other atypical situations).

The next important element in the standardization of forensic science is the procedure for training and certification of staff to give them permission to conduct forensic examination.

Art. 20-23 of the bill: 6284 sets out the requirements for professional training, qualification and certification of a forensic expert, as well as sets out the conditions and features of the work of expert qualification commissions of forensic experts. However, with regard to subordination of such a commission, it is mentioned only that it is formed *"under the state regulatory bodies* which head of approves its composition (Article 22) [79].

Draft Law 6284-1 in Art. 32 provides for establishment of expert-qualification commissions, but *"in state specialized forensic institutions <...> state bodies to whose sphere of management these institutions belong"* [80]. In other words,, this project leaves unchanged the practice of the existence of various bodies of different departmental subordination, which will determine the qualification of a forensic expert. In addition, Art. 37 contains provisions according to which the qualification class of a forensic expert is not provided to servicemen and those who have the rank of rank and file and senior staff [81].

According to Art. 7 of the draft Law 6284-2, state regulation of forensic activities (for conducting forensic activities by state and non-state forensic institutions, as well as private forensic experts) should be carried out by the National Expert Service of Ukraine[82]. The National Expert Service of Ukraine, for its part, forms expert-qualification commissions of forensic experts consisting of permanent and alternate members (Article 16) [83]. It is the expert-qualification commissions of forensic experts that are empowered to determine the level of knowledge of persons seeking the status of forensic expert, and the level of qualification of forensic experts and other issues of admission of forensic experts to conduct their forensic science activity.

To some extent, the authors of the draft Law 6284-3, Art. 17 provides for the establishment of expert qualification commissions *""under ministries and other central executive bodies which management includes state specialized institutions engaged in forensic activity"* [84]. However, even more surprising is the proposal to

експерта. *Криміналістичний вісник.* 2016. № 1 (25). С. 36—41. URL: https://elar.naiau.kiev.ua/jspui/handle/123456789/1827 (date accessed: 12.02.2022) ; Щербаковский М. Г., Щербаковская Л. П. Компетенция и компетентность судебного эксперта. *Криминалистика и судебная экспертиза*. 2013. Вып. 58. Ч. 2. С. 95—104. URL: https://dspace.univd.edu.ua/xmlui/bitstream/handle/123456789/1381/kompetenciya_i_kompetentnost_sudebnogo_e.pdf?sequence=2&isAllowed=y (date accessed: 12.02.2022).

79 Проєкт Закону ... № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

80 Проєкт Закону ... № 6284-1. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

81 Ibid.

82 Проєкт Закону ... № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

83 Ibid.

84 Проєкт Закону ... № 6284-3. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

establish such commissions at public organizations in order to assess the qualification level of experts or to grant permission to carry out expert activities on a private basis [85].

Next we will consider the proposals of lawmakers on guarantees of judicial expertise, namely: a special procedure for obtaining the status of forensic expert, immunity from interference in professional activities, the nuances of disciplinary liability.

The bill: 6284 in Art. 26 connects the activity beginning of forensic expert with the date of "*entering information about him in the Register of forensic experts*" [86]. According to Art. 27 of the same draft "*information that according to this Law is subject to entry in the Register of Forensic Experts, shall be included in it no later than three calendar days from the date of receipt by the holder of this register of relevant information*" [87].

Art. 34 of the bill: 6284-1 provides:

"Certificate of qualification of a forensic expert with the right to conduct forensic examinations in a particular expert specialty (hereinafter referred to as Certificate) is issued to a person within three working days from the date of the decision of the relevant commission.

The certificate can be issued in paper or electronic form, in compliance with the law.

The right to perform forensic examinations in a certain science specialization is granted for five years" [88].

Accordingly, this bill connects the actual possibility of conducting forensic examinations with the issuance moment of the certificate by the relevant Expert Qualification Commission.

A similar procedure for obtaining the status of a forensic expert is proposed in the bill: 6284-2.

The bill: 6284-3 does not provide for the procedure for acquiring the status of a forensic expert instead the *forensic expert certification* term is used[89]. The result of successful certification, according to the logic of the authors of the bill, is the qualification of a forensic expert by the relevant expert qualification commission with subsequent receipt of the certificate and registration of the latter in one of the Registers of Certified Forensic Experts.

In our opinion, acquisition of the status of a forensic expert is most fully set out in Bills 6284 and 6284-1.

Let's consider what the proposed bills on the remuneration of forensic experts. Scientists have repeatedly noted that in practice there are no single criteria for approaching its size [90].

According to Art. 58 of the draft Law 6284 some components of the salary of a forensic expert must be determined

85 Дудич А. В. Вимоги, які пред'являють до особи судового експерта як учасника кримінального провадження. *Наше право*. 2015. № 1. С. 96—102. URL: https://nbuv.gov.ua/UJRN/Nashp_2015_1_19 (date accessed: 12.02.2022).

86 Проєкт Закону … № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

87 Ibid.

88 Проєкт Закону … № 6284-1. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

89 Проєкт Закону … № 6284-3. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

90 Шум С. С. Деякі процесуальні аспекти проведення судово-психіатричної експертизи. *Форум права*. 2013. № 1. С. 1212—1218. URL: https://nbuv.gov.ua/UJRN/FP_index.htm_2013_1_201 (date accessed: 12.02.2022).

by the Cabinet of Ministers of Ukraine, therefore, they are not regulated at the level of the legislative act [91].

Bill 6284-1, in determining remuneration of forensic experts, leaves the distribution of part of the funds to the government. Instead, Part 2 of Art. 58 of this bill proposes to determine the salary of a forensic expert *"in the amount of not less than 10 times the subsistence level established for able-bodied persons on January 1 of the calendar year"* [92]. It should be noted that the same amount of the salary of a forensic expert has long been enshrined in Part 2 of Art. 18 of the core Law [93], but from 2018 until today the next Law on the State Budget of Ukraine legislator annually suspends this rule [94].

Regarding the remuneration of employees (employees) of state forensic institutions, Art. 53 of the bill 6284-2 literally repeats Art. 58 of the draft Law 6284 [95].

The proposal on the size of the salary of a forensic expert not less than 10 subsistence minimums established for able-bodied persons on January 1 of the calendar year, similar to that laid down in Part 2 of Art. 58 of the bill 6284-1, also contains part 2 of Art. 18 of the bill 6284-3 [96].

Conclusions

Summing up the comparative legal research on the bills regulating forensic science, we should note that the most fully advanced achievements in forensic science and recommendations of practitioners correspond to the draft Law 6284. Certainly, other proposals also have a right to exist (at least some components) but the point in this discussion should put the Verkhovna Rada of Ukraine.

Порівняльна характеристика законопроєктів про судово-експертну діяльність

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Оскільки з моменту прийняття 1994 р. Закону України «Про судову експертизу» забезпечення правосуддя висновками експертів зазнало суттєвих змін, то виникла нагальна потреба оновити нормативні акти, якими врегульовано питання судово-експертної діяльності. Саме тому народні депутати 6-ї сесії IX скликання як суб'єкти законодавчої ініціативи подали до Верховної Ради України низку законопроєктів щодо реформування судово-експертної діяльності в нашій державі, порівняльний огляд яких тут презентовано. Також розглянуто основні

91 Проєкт Закону … № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

92 Проєкт Закону … № 6284-1. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

93 Про судову експертизу : … . URL: http://zakon.rada.gov.ua/cgibin/laws/main.cgi?nreg=4038-12 (date accessed: 20.09.2021).

94 E.g.: Про Державний бюджет України на 2018 рік : Закон України від 07.12.2017 р. № 2246-VIII (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/2246-19#Text (date accessed: 20.02.2022) ; Про Державний бюджет України на 2019 рік : Закон України від 23.11.2018 р. № 2629-VIII (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/1928-20#Text (date accessed: 23.02.2022) та ін.

95 Проєкт Закону … № 6284. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 12.02.2022).

96 Проєкт Закону … № 6284-3. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?id=&pf3511=73246 (date accessed: 12.02.2022).

термінологічні та правові особливості регламентування судово-експертної діяльності, її змісту і статусу її учасників. Виокремлено основні критерії реформування й напрями розвитку законодавства про судово-експертну діяльність закордоном. Наведено стислий огляд історичного розвитку законодавства про судово-експертну діяльність в Україні. Окреслено основні способи формування дефініцій у нормативному регулюванні судово-експертної діяльності та її суб'єктів. Надано обґрунтовані пропозиції щодо врегулювання судово-експертних правовідносин. Запропоновано усунути виявлені недоліки законопроєктів.

Мета статті — на підставі порівняльного аналізу нормативно-правових актів з питань судової реформи, поданих до Верховної Ради України впродовж вересня 2021 р.— січня 2022 р. (6-та сесія IX скликання) суб'єктами законодавчої ініціативи, і зважаючи на сучасний стан наукової дискусії — сформулювати практично обґрунтовані пропозиції для визначення оптимальної побудови в Україні системи та структури установ і посадових осіб, які мають право здійснювати судово-експертну діяльність.

Ключові слова: *судовий експерт; судова експертиза; законодавче регулювання судово-експертної діяльності; суб'єкти судово-експертної діяльності; проєкти нормативних актів про судово-експертну діяльність.*

Сравнительная характеристика законопроектов о судебно-экспертной деятельности

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Поскольку с момента принятия в 1994 г. Закона Украины «О судебной экспертизе» обеспечение правосудия заключениями экспертов претерпело существенные изменения, возникла насущная необходимость обновить нормативные акты, регулирующие вопросы судебно-экспертной деятельности. Именно поэтому народные депутаты 6-й сессии IX созыва как субъекты законодательной инициативы подали в Верховную Раду Украины ряд законопроектов относительно реформирования судебно-экспертной деятельности в нашем государстве, сравнительный обзор которых здесь представлен. Также рассмотрены основные терминологические и правовые особенности регламентирования судебно-экспертной деятельности, её содержания и статуса её участников. Выделены основные критерии реформирования и направления развития законодательства о судебно-экспертной деятельности за рубежом. Приведён краткий обзор исторического развития законодательства о судебно-экспертной деятельности в Украине. Очерчены основные способы формирования дефиниций в нормативном регулировании судебно-экспертной деятельности и её субъектов. Представлены обоснованные предложения по урегулированию судебно-экспертных правоотношений. Предложено устранить выявленные недостатки законопроектов.

Цель статьи — на основании сравнительного анализа нормативно-правовых актов по вопросам судебной реформы, поданных в Верховную Раду Украины в течение сентября 2021 г.— января 2022 г. (6-я сессия IX созыва) субъектами законодательной инициативы, и с учётом современного состояния научной дискуссии — сформулировать практически обоснованные предложения для определения оптимального построения в Украине системы и структуры учреждений и должностных лиц, имеющих право осуществлять судебно-экспертную деятельность.

Ключевые слова: *судебный эксперт; судебная экспертиза; законодательное*

регулирование судебно-экспертной деятельности; субъекты судебно-экспертной деятельности; проекты нормативных актов о судебно-экспертной деятельности.

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References

Alenin, Iu. P. i dr. (2005). *Ugolovno-protsessualnyi kodeks Ukrainy* [Criminal Procedure Code of Ukraine] : nauch.-prakt. komment. / pod obshch. red. V. T. Maliarenko, Iu. P. Alenina. Kharkov [in Russian].

Antoniuk, P. Ye. (2016). Shchodo profesiinoi kompetentnosti sudovo-medychnoho eksperta [Regarding the professional competence of a forensic expert]. *Kryminalistychnyi visnyk*. № 1 (25). URL: https://elar.naiau.kiev.ua/jspui/handle/123456789/1827 [in Ukrainian].

Avdieieva, H. K. (2015). Problemy harmonizatsii zakonodavstva Ukrainy u haluzi sudovoi ekspertyzy iz zakonodavstvom krain Yevropeiskoho Soiuzu [Harmonization issues of Ukrainian legislationin the field of forensic science with European Union legislation]. *Aktualni pytannia dosudovoho rozsliduvannia ta suchasni tendentsii rozvytku kryminalistyky* : matly mizhnar. nauk.-prakt. konf. (Kharkiv, 05.12.2014). Kharkiv [in Ukrainian].

Banchuk, O. (2021). *Skhvalenyi Uriadom zakonoproiekt pro sudovo-ekspertnu diialnist dozvolyt vyrishyty holovni problemy u tsii sferi* [The draft law on forensic expert activity approved by the Government will allow to solve the main problems in this field] / Novyny Ministerstva. 03-11-2021 // Ofits. sait Miniustu Ukrainy. URL: https://minjust.gov.ua/news/ministry/oleksandr-banchuk-shvaleniy-uryadom-zakonoproekt-pro-sudovo-ekspertnu-diyalnist-dozvolit-virishiti-golovni-problemi-u-tsiy-sferi [in Ukrainian].

Cherdantsev, A. F. (1972). *Iuridicheskie konstruktsii, ikh rol v nauke i praktike* [Legal constructions, their role in science and practice]. *Izvestiia vuzov. Pravovedenie*. № 3 [in Russian].

Chornous, Yu. M., Lopata, O. A. (2016). Poniattia ta zavdannia sudovo-ekspertnoi diialnosti u suchasnykh realiiakh [The notion and tasks of forensic expert activity in modern realities]. *Kryminalistyka i sudova ekspertyza*. Vyp. 61. URL: https://nbuv.gov.ua/UJRN/krise_2016_61_3 [in Ukrainian].

Dudych, A. V. (2015). Vymohy, yaki prediavliaiut do osoby sudovoho eksperta yak uchasnyka kryminalnoho provadzhennia [Requirements for forensic expert as a participant in criminal proceedings]. *Nashe pravo*. № 1. URL: https://nbuv.gov.ua/UJRN/Nashp_2015_1_19 [in Ukrainian].

Dudych, A. V. (2017). *Ekspert yak uchasnyk kryminalnoho provadzhennia* [An Expert as a Participant of the Criminal Proceedings]: avtoref. dys. ... kand. yuryd. nauk. Odesa [in Ukrainian].

Golovchenko, L. N. (2002). Reformirovanie sistemy ehkspertnogo obespecheniia pravosudiia v Ukraine [Reforming system of science support justice in Ukraine]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky* : mat-ly mizhnar. nauk.-prakt. konf. (Kharkiv, 19—20.06.2002). Vip. 2 [in Russian].

Holovchenko, L. M. (2008). Zmistovna rol naukovo-praktychnykh komentariv do Zakonu Ukrainy «Pro sudovu ekspertyzu» [Substantial role of scientific and practical comments on the Law of Ukraine: On Judicial Examination.]. *Aktualni pytannia sudovoi ekspertyzy ta kryminalistyky* : zb. mat-liv zasid. «kruhl. stolu», prysviach. 85-rich. stvor. KhNDISE im. Zasl. prof. M. S. Bokariusa (Kharkiv, 11—12.11.2008). Kharkiv [in Ukrainian].

Hrytsak, S. V. (2013). *Adaptatsiia informatsiinoho zakonodavstva Ukrainy do norm Yevropeiskoho Soiuzu* [Adaptation of the information legislation of Ukraine to the norms of the European Union] : avtoref. dys. ... kand. yuryd. nauk. Zaporizhzhia [in Ukrainian].

Kaminskii, M. K. (2011). Spetsialnye znaniia — sila? [Is special knowledge a real power?]. *Kryminalist pershodrukovanyi*. № 3 [in Russian].

Kataraga, O., Petkovich, P. (2019). Sistema sudebnoi ehkspertizy v respublike Moldova. Problematika [Forensic science system in the Republic of Moldova. Problems]. *Sudova ekspertyza: suchasnist ta maibutnie* : mat-ly kruhl. stolu (Lviv, 25—26.01.2019) ; za zah. red. d-ra tekhn. nauk. M. O. Kuzina. Lviv [in Russian].

Khalfina, R. O. (1974). *Obshchee uchenie o pravootnoshenii* [General doctrine on legal relations] : monografiia. Moskva [in Russian].

Kliuiev, O. M. (2018). Do pytannia mizhnarodnoho spivrobitnytstva v haluzi sudovoi ekspertyzy [About international cooperation in the field of forensic science]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 18. DOI: 10.32353/khrife.2.2018.17 [in Ukrainian].

Kliuiev, O. M. (2019). Udoskonalennia ekspertnoho zabezpechennia pravosuddia: teoretychni, pravovi ta orhanizatsiini aspekty [Improvement of forensic support: theoretical, legal and organizational aspects]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 19. DOI: 10.32353/khrife.1.2019.08 [in Ukrainian].

Kliuiev, O. M. (2020). Reformuvannia bazovoho zakonodavstva Ukrainy z pytan ekspertnoho zabezpechennia pravosuddia — nahalna potreba chasu [Reforming basic legislation of Ukraine on the issues of forensic science support to justice is an urgent need of the time]. *Problemy reformuvannia bazovoho zakonodavstva Ukrainy z pytan ekspertnoho zabezpechennia pravosuddia* : mat-ly kruhl. stolu (Kharkiv, 06—07.02.2020). Kharkiv. URL: https://www.hniise.gov.ua/user_files/File/other/13%20%D0%BF%D0%BE%D1%81%D0%BB%D0%B5%D0%B4%D0%BD%D1%8F%D1%8F%20%D0%BD%D0%B0%20%D0%BF%D0%B5%D1%87%D0%B0%D1%82%D1%8C.pdf [in Ukrainian].

Kliuiev, O. M. (2021). Mizhnarodne naukove spivrobitnytstvo — efektyvnyi mekhanizm udoskonalennia sudovo-ekspertnoi diialnosti [International scientific cooperation is an effective

mechanism for improving forensic science]. *Aktualni pytannia sudovoi ekspertyzy i kryminalistyky* : zb. mat-liv mizhnar. nauk.-prakt. konf.-polilohu (Kharkiv, 15—16.04.2021). Kharkiv. URL: https://www.hniise.gov.ua/uploads/files/public-folder/2021_tezy_konference%20in%20print5.pdf [in Ukrainian].

Kovalevska, Ye. V. (2017). Protsesualni ta kvalifikatsiini vymohy do pravosubiektnosti spetsialista-medyka ta sudovoho eksperta, yaki berut uchast u kryminalnomu provadzhenni [Procedural and Educational Requirements for Legal Personality of Medical Specialist and Forensic Expert Participating in Criminal Proceedings]. *Yurydychnyi chasopys Natsionalnoi akademii vnutrishnikh sprav.* № 2 (14). URL: https://elar.naiau.kiev.ua/jspui/handle/123456789/5186 [in Ukrainian].

Liubchenko, S. O., Nizovtsev, Yu. Yu., Parfylo, O. A. (2015). *Systema zabezpechennia sudovo-ekspertnoi diialnosti v derzhavakh — chlenakh NATO* [Forensic science system in NATO member states] : nauk.-prakt. ohliad / za zah. red. O. A. Parfylo. Kyiv [in Ukrainian].

Manzhula, A. A. (2015). *Problemy orhanizatsii diialnosti naukovo-doslidnykh ustanov v Ukraini* [Issues of organizing activities of research institutions in Ukraine] : monohrafiia. Kharkiv [in Ukrainian].

Nekrakha, D. O., Okhrimenko, O. I. (2015). Stan ta perspektyvy ekspertnykh doslidzhen v SBU, okremi problemni pytannia [The condition and perspectives of expert researches in the SSU, separate problem questions]. *Krymynalystyka y sudebnaia ekspertyza*. Vyp. 60. URL: https://kndise.gov.ua/activity/metodics [in Ukrainian].

Onopriienko, S. A., Naranovych, O. V., Spasenko, I. O. (2019). Shchodo pytannia provedennia mizhlaboratornykh porivnian pid chas sudovo-ekspertnoi diialnosti [On the issue of risk managementand assessment in the activitiesof ukrainian forensic institutions]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky.* Vyp. 20. DOI: 10.32353/khrife.2.2019.12 [in Ukrainian].

Ovsiannykova, I. M. (2019). Orhanizatsiia diialnosti sudovo-ekspertnykh ustanov v Ukraini yak skladna systema [Management of forensic science institutions in Ukraine as a complex system]. *Sudova ekspertyza: suchasnist ta maibutnie* : mat-ly kruhl. stolu (Lviv, 25—26.01.2019) ; za zah. red. d-ra tekhn. nauk. M. O. Kuzina. Lviv [in Ukrainian].

Ovsiannykova, I. M. (2019). Osnovni zasady vyznachennia efektyvnosti sudovo-ekspertnoi diialnosti: administratyvno-pravovyi aspekt [Main approaches to determining the effectiveness of forensic expert activity: administrative and legal aspects]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 20. DOI: 10.32353/khrife.2.2019.16 [in Ukrainian].

Ovsiannykova, I. M. (2020). Sudovo-ekspertna diialnist yak obiekt administratyvno-pravovoho rehuliuvannia [Forensic activity as an object of administrative and legal regulation]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky.* Vyp. 21. DOI: 10.32353/khrife.1.2020.17 [in Ukrainian].

Polianskyi, A. O., Yuodkaitie-Granskiienie, G. (2020). Shchodo klasyfikatsii zavdan zahalnoi teorii sudovoi ekspertyzy i praktychnoi sudovo-ekspertnoi diialnosti (ohliadova stattia) [Administrative and Legal Principles of the Interaction between Forensic Institutions and Law Enforcement Agencies (Review article)]. *Teoriia*

ta praktyka sudovoi ekspertyzy i kryminalistyky. Vyp. 22. DOI: 10.32353/khrife.2.2020.13 [in Ukrainian].

Popovych, Ye. M. (2018). Pryntsypy orhanizatsii ta funktsionuvannia avtomatyzovanykh sytem u sudovo-ekspertnii diialnosti [Principles of organization and functioning of automated systems in forensic expert activity]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 18. DOI: 10.32353/khrife.2018.27 [in Ukrainian].

Popovych, Ye. M. (2019). Yednist nauky ta praktyky v sudovo-ekspertnii diialnosti [Unity of science and practice in legal expertise]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 19. DOI: 10.32353/khrife.1.2019.012 [in Ukrainian].

Pyrih, I. V. (2020). Informatsiine zabezpechennia ekspertnoi diialnosti [Information support of forensic expert activity]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 21. DOI: 10.32353/khrife.1.2020.12 [in Ukrainian].

Segai, M. Ia. (2003). Sudebnaia ehkspertologiia: obieekt, predmet, priroda i sistema nauki [Forensic Expertology: Object, Subject, Nature and System of Science]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vip. 3 [in Russian].

Shcherbakovskii, M. G., Shcherbakovskaia, L. P. (2013). Kompetentsiia i kompetentnost sudebnogo ehksperta [Competence and proficiency of a forensic expert]. *Kriminalistika i sudebnaia ehkspertiza*. Vyp. 58. Ch. 2. URL:https://dspace.univd.edu.ua/xmlui/bitstream/handle/123456789/1381/kompetenciya_i_kompetentnost_sudebnogo_e.pdf?sequence=2&isAllowed=y [in Russian].

Shcherbakovskyi, M. H. (2015). *Provedennia ta vykorystannia sudovykh ekspertyz u kryminalnomu provadzhenni* [Conducting and using forensic examinations in criminal proceedings] : monohrafiia. Kharkiv [in Ukrainian].

Shcherbakovskyi, M. H. (2020). Spivvidnoshennia ta struktura kryminalistychnoi tekhniky y sudovoi ekspertolohii [Correlation and structure of a forensic technique and forensic science]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 21. DOI: 10.32353/khrife.1.2020.09 [in Ukrainian].

Shcherbakovskyi, M. H., Kurylenko, D. V. (2019). Obiznani osoby v sudochynstvi Ukrainy (ohliadova stattia) [Expert witness in Ukrainian legal proceedings]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 19. DOI: 10.32353/khrife.1.2019.011 [in Ukrainian].

Shepitko, M. V. (2019). Problemy vyiavlennia ta rozsliduvannia zlochyniv proty pravosuddia, shcho vchyniaiutsia profesiinymy uchasnykamy sudochynstva (provadzhennia) [Problems of detection and investigation of crimes against justice committed by professional participants of legal proceedings]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 19. DOI: 10.32353/khrife.1.2019.04 [in Ukrainian].

Shepitko, V. Yu. (2020). Formuvannia kryminalistyky ta kryminalistychnoi dydaktyky v Ukraini [Formation of criminalistics and forensic didactics in Ukraine]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 22. DOI: 10.32353/khrife.2.2020.01 [in Ukrainian].

Shepitko, V. Yu. (2020). Problemy normatyvno-pravovoho rehuliuvannia sudovo-ekspertnoi diialnosti v Ukraini [Issues of normative-legal

regulation of forensic science activity in Ukraine]. *Problemy reformuvannia bazovoho zakonodavstva Ukrainy z pytan ekspertnoho zabezpechennia pravosuddia* : mat-ly kruhl. stolu (Kharkiv, 06—07.02.2020). Kharkiv [in Ukrainian].

Shepitko, V. Yu., Avdieieva, H. K. (2019). Problemy zastosuvannia naukovo-tekhnichnykh zasobiv ta innovatsiinykh produktiv u diialnosti orhaniv pravoporiadku [Problems of use of scientific and technical means and innovative products in the activities of pre-judicial investigation bodies]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 20. DOI: 10.32353/khrife.2.2019.01 [in Ukrainian].

Shum, S. S. (2013). Deiaki protsesualni aspekty provedennia sudovo-psykhiatrychnoi ekspertyzy [Some of the Procedural Aspects of the Forensic Psychiatric Examination]. *Forum prava*. № 1. URL: https://nbuv.gov.ua/UJRN/FP_index.htm_2013_1_201 [in Ukrainian].

Simakova-Yefremian, E. B. (2017). Do pytannia vzaiemozalezhnosti yevropeiskykh intehratsiinykh protsesiv i tendentsii intehratsii spetsialnykh znan v Ukraini [On the Issue of Interdependence of European Integration Processes and Trends in Integration of Specific Expertise in Ukraine]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 17. URL: https://irbis-nbuv.gov.ua/cgi-bin/irbis_nbuv/cgiirbis_64.exe?C21COM=2&I21DBN=UJRN&P21DBN=UJRN&IMAGE_FILE_DOWNLOAD=1&Image_file_name=PDF/Tpsek_2017_17_22.pdf [in Ukrainian].

Simakova-Yefremian, E. B. (2017). *Teoretyko-pravovi ta metodolohichni zasady kompleksnykh sudovo-ekspertnykh doslidzhen* [Theoretical, legal and methodological principles of complex forensic research] : avtoref. dys. … d-ra yuryd. nauk. Kharkiv [in Ukrainian].

Simakova-Yefremian, E. B. (2019). Do pytannia pro neobkhidnist vnesennia zmin do statti 1 Zakonu Ukrainy pro sudovu ekspertyzu [On the issue of the need to amend Article 1 of the Law of Ukraine: On Judicial Examination]. *Sudova ekspertyza: suchasnist ta maibutnie* : mat-ly kruhl. stolu (Lviv, 25—26.01.2019) ; za zah. red. d-ra tekhn. nauk. M. O. Kuzina. Lviv [in Ukrainian].

Simakova-Yefremian, E. B. (2019). Do pytannia pro vvedennia u kryminalne protsesualne zakonodavstvo poniattia «vysnovok spetsialista» [On the issue of introducing the concept of specialistconclusion to criminal procedure legislation]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 20. DOI: 10.32353/khrife.2.2019.07 [in Ukrainian].

Simakova-Yefremian, E. B. (2019). Pro neobkhidnist udoskonalennia zakonodavstva shchodo zdiisnennia sudovo-ekspertnoi diialnosti v Ukraini [On the need for improvement of legislation regarding implementation of forensic science activities in Ukraine]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 19. DOI: 10.32353/khrife.1.2019.09 [in Ukrainian].

Sniherov, O. P., Andrenko, S. O. (2018). Do pytannia z vyznachennia poniattia sudovoi ekspertyzy v administratyvnomu provadzhenni (ohliadova stattia) [About concept definition of forensic science in administrative proceedings. (Review article)]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 18. DOI: 10.32353/khrife.2018.25 [in Ukrainian].

Strilets, H. O. (2009). *Henezys systemy sudovo-ekspertnykh ustanov v Ukraini ta napriamky yikh diialnosti* [Genesis of the system of forensic expert institutions in Ukraine and the areas of their activity] : avtoref. dys. … kand. yuryd. nauk. Kyiv [in Ukrainian].

Uhrovetskyi, O. P., Sviderskyi, O. O. (2019). Napriamky formuvannia suchasnoho teoretychnoho pidgruntia sudovo-ekspertnoi diialnosti v Ukraini [Directions of formation of modern

theoretical basis of forensic science activity in Ukraine]. *Sudova ekspertyza: suchasnist ta maibutnie* : mat-ly kruhl. stolu (Lviv, 25—26.01.2019) ; za zah. red. d-ra tekhn. nauk. M. O. Kuzina. Lviv [in Ukrainian].

Vasyliev, V. M. (2020). Sudova ekspertyza u tsyvilnomu ta hospodarskomu provadzhenni yak okrema forma zastosuvannia spetsialnykh znan [Forensic examination in civil and economic proceedings as a separate form of special knowledge use]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 21. DOI: 10.32353/khrife.1.2020.08 [in Ukrainian].

Juodkaitė-Granskienė, G., Frolov, M. (2022). Comparative characteristics of bills on forensic science. *Theory and Practice of Forensic Science and Criminalistics.* Issue 1 (26). P. 24—51. DOI: 10.32353/khrife.1.2022.03.

Stages of expert research and their application in the forensic veterinary examination of animal carcasses

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It is proved that stages of expert research during forensic veterinary examination of animal carcasses are based on general methodological provisions of forensic science and contain at least four stages: preparatory (preliminary research), analytical (separate research), comparative, synthesizing (evaluation), not only reflecting the procedure of expert knowledge of properties of forensic veterinary examination objects, but also allowing to trace the process of examination and evaluate the results obtained during evaluation of the expert conclusion.

Each stage of expert research of animal carcasses is conditioned by various technical methods and tasks of research and provides the solution of intermediate tasks, which are mainly diagnostic in nature. The commonality of the stages reflects general points characteristic of any expert research as one of the varieties of forms of cognition. The variety lies in the part and number of same-named stages in the structure of diagnostic studies. The order of application of these stages contributes to a logically correct analysis of the pathomorphological features, and (on the basis of their comprehensive evaluation) formulation of the forensic veterinary diagnosis and the final expert conclusion.

A procedure for removing objects from an animal carcass and their subsequent laboratory examination, rules forensic veterinary examination of animal carcasses, guidelines for describing and assessing the condition of body parts and organs of the animal carcass, the conclusion of a forensic veterinary expert, have been developed.

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Keywords: *forensic veterinary examination; animal carcasses; stages of expert research; process and tasks of diagnostic research; expert conclusion; techniques for describing and assessing the condition of body parts and organs of an animal carcass.*

Formulation of Research Problem

In 2019, at the initiative of National Scientific Center «Hon. Prof. M. S. Bokarius Forensic Science Institute» in the institutions of forensic science of the Ministry of Justice of Ukraine, a new type of forensic examination — forensic veterinary examination was launched [1], which is a scientific study of objects performed by a veterinarian — forensic veterinary expert in order to provide the conclusion on issues that arose during the pre-trial investigation in criminal proceedings or the trial in any type of proceedings [2]. This type of forensic examination has recently been actively not only in Ukraine but also in the rest of world [3].

Since the conceptual theoretical provisions of forensic veterinary examination are currently in the process of formation, there is an urgent need for their development, and experimental and practical justification [4]. One of such directions is the doctrine of stages of the expert research and their application in forensic veterinary examination [5].

Analysis of Essential Researches and Publications

International and national legislation accurately regulates the organization and conduct of forensic examination [6]. However, in Ukraine there are still no legally

1 Клюєв О. М. Удосконалення експертного забезпечення правосуддя: теоретичні, правові та організаційні аспекти. *Теорія та практика судової експертизи і криміналістики*. 2019. Вип. 19. С. 102—117. DOI: 10.32353/khrife.1.2019.08 (date accessed: 08.09.2021) ; Яценко І. В., Дереча Л. М. Можливості судово-ветеринарної експертизи як нового виду судових експертиз. *Ibid*. С. 550—567. DOI: 10.32353/khrife.1.2019.044 (date accessed: 08.09.2021).

2 Mills G. Proving the crime: how veterinary forensics can help. *Veterinary record*. 2013. Vol. 172 (18). P. 465. DOI: 10.1136/vr.f2694 (date accessed: 08.09.2021).

3 Ottinger T., Rasmusson B., Segerstad C. H. A., Merck M., Goot F. V. D., Olsen L., Gavier-Widen D. Forensic veterinary pathology, today's situation and perspectives. *Ibid*. 2014. Vol. 175. Is. 18. P. 459. DOI: 10.1136/vr.102306 (date accessed: 08.09.2021).

4 Яценко І. В., Париловський О. І. Новітні досягнення в судово-ветеринарній експертизі тварин, постраждалих від жорстокого поводження. *Науковий вісник Львівського національного університету ветеринарної медицини та біотехнологій ім. С. З. Ґжицького. Серія: Ветеринарні науки*. 2020. Т. 22. № 97. С. 95—105. DOI: 10.32718/nvlvet9716 (date accessed: 08.09.2021).

5 Основи судової експертизи: навчальний посібник для фахівців, які мають намір отримати або підтвердити кваліфікацію судового експерта / авт.-уклад.: Л. М. Головченко, А. І. Лозовий, Е. Б. Сімакова-Єфремян та ін. Харків, 2016. 928 с.

6 Сімакова-Єфремян Е. Б. До питання взаємозалежності європейських інтеграційних процесів і тенденцій інтеграції спеціальних знань в Україні. *Теорія та практика судової експертизи і криміналістики*. 2017. Вип. 17. С. 152—158 ; Інструкція про призначення та проведення судових експертиз та експертних досліджень : затв. наказом Мін'юсту України від 08.10.1998 р. № 53/5 (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/z0705-98#Text (date accessed: 20.02.2022) ; Про судову експертизу : Закон України від 25.02.1994 р.

established regulated procedures for its conduct. In this regard, the development of all urgent issues of veterinary forensics is due to the need to properly classify the offenses committed against animal life and health, as well as the need of society for a fair trial [7].

Modern forensic veterinary examination is supplemented by the latest scientific research, which specialists are actively implementing and using in forensic science. Thus, new developments have enriched the theory and practice of forensic veterinary examination of live experimental animals [8], as well as the animal carcasses whose death were caused by cruel treatment or illegal hunting [9]. In the research work *"Development of guidelines for determining the severity of injures to animals"* (state registration number 0120U101976) of National Scientific Center «Hon. Prof. M. S. Bokarius Forensic Science Institute» developed rules for determining the severity of damage caused to the health of experimental animal; separately determined and substantiated forensic veterinary criteria and signs of harm to health, dangerous to the life of the animal; the order of forensic veterinary determination of the severity of the damage caused to the animal's health is covered; forensic veterinary criteria of injures penetrating into the body cavities of the animal are substantiated; forensic veterinary signs of moderate and mild damage to the animal's health are characterized. It is proved that individual fractures, dislocations and subluxations of individual bones of the animals' skeleton should be classified as serious injuries.

Another area of forensic veterinary examination is a forensic veterinary examination of animal carcasses [10]. To eliminate gaps in this area of expert activity in the research work *"Development of forensic veterinary examination's methods of animal carcasses"* (state registration number 0121U100299) analyzed forensic cases of the examination of animal carcasses with signs of violent death from cruel treatment, developed and substantiated algorithms for forensic veterinary examination of animal carcasses with signs of violent death, clinical and morphological epicrisis of multimorbid animal pathology, the procedure for forensic veterinary examination of animal carcasses in the hall of a specialized expert institution, forensic veterinary determination of animals'

№ 4038-XII (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/4038-12#Text (date accessed: 20.02.2022) ; Brinkmann B. Harmonisation of Medico-Legal Autopsy Rules. *International Journal of Legal Medicine.* 1999. Vol. 113 (1). Pp. 1—14. DOI: 10.1007/s004140050271 (date accessed: 20.02.2022) ; Munro R., Ressel L., Gröne A., Hetzel U., Jensen H. E., Paciello O., Kipar A. European Forensic Veterinary Pathology Comes of Age. *Journal of Comparative Pathology*. 2020. Vol. 179. Pp. 83—88. DOI: 10.1016/j.jcpa.2020.08.003 (date accessed: 20.02.2022).

7 Brooks Brownlie H. W., Munro R. The Veterinary Forensic Necropsy: A Review of Procedures and Protocols. *Veterinary Pathology.* 2016. Vol. 53 (5). Pp. 919—928. DOI: 10.1177/0300985816655851 (date accessed: 20.02.2022) ; Brinkmann B. Op. cit.

8 Яценко І. В., Дереча Л. М., Париловський О. І. Новітні наукові й практичні здобутки та перспективи розвитку судово-ветеринарної експертизи живих тварин в Україні. *Актуальні питання та перспективи розвитку судової експертизи та криміналістики* : мат-ли Міжнар. наук.-практ. конф. (Одеса, 03.09.2021). Одеса, 2021. С. 368—373.

9 Яценко И., Дереча Л., Казанцев Р. Новейшие научные и практические достижения и перспективы развития судебно-ветеринарной экспертизы трупов животных в Украине. *Legea şi Viaţa.* 2021. № 1. Vol. II. Pp. 94—99.

10 Mangematin G. Post-mortem examination in food-producing animals. Regulations and standards. *Point veterinaire.* 1999. Vol. 30 (203). Pp. 33—36.

poisoning with medicine containing cardiac glycosides, based on pathomorphological examination, the forensic veterinary examination and evaluation criteria for fatal gunshot wounds of animals.

As indicated above, the development of these and other issues of forensic veterinary examination is due to the need of law enforcement agencies in the correct classification of offenses against animal life and health, and society - in a fair trial [11]. Expert research is the cognitive activity of a forensic expert - a complex creative process based on the latest advances in science and technology, awareness of modern effective research methods and expert skills [12].

During the forensic veterinary examination or expert research to perform a specific expert task, specialists use appropriate research methods and techniques, outline ways and means of its implementation, taking into account the stage of forensic veterinary examination [13]. Determining the method of examination belongs to the competence of the expert.

The specifics of the subject and objects of forensic veterinary examination determines the specifics of the study's stages. Operations that form separate stages of the expert research — the application of the laws of objective reality to acquire new knowledge [14]. Stages of forensic veterinary examination are formed on the basis of the relevant tested expert procedures, the nature of qualities of the examination's object, the experience of solving practical expert tasks.

Adherence to the stages of forensic veterinary examination largely ensures the effectiveness, reliability and objectivity of the study's results, which is expressed in its effectiveness, legality, verification, etc. [15].

The relevance of this work is primarily due to the lack of sufficient theoretical basis for forensic veterinary examination in the domestic scientific literature (systematic analysis and clear differentiation of stages of such examination) and the need to implement scientific developments in the expert practice of animal carcasses.

Objective of the work

To reveal the essence, functions and significance of the stages of expert research in forensic veterinary examination of animal carcasses.

Main Content Presentation

In the process of any expert research, including forensic veterinary, based on general guidelines, regardless of the tasks, it is advisable to distinguish four stages: *preparatory (*preliminary research*),*

11 Benetato M. A., Reisman R., McCobb E. The veterinarian's role in animal cruelty cases. *Javma* : Journal of the American Veterinary Medical Association. 2011. Vol. 238. Is. 1. Pp. 31—34. DOI: 10.2460/javma.238.1.31 (date accessed: 20.02.2022).

12 McDonough S. P., McEwen B. J. Veterinary Forensic Pathology: The Search for Truth. *Veterinary Pathology*. 2016. Vol. 53. Is. 5. Pp. 875—877. DOI: 10.1177/0300985816647450 (date accessed: 20.02.2022).

13 Byard R. W., Boardman W. The potential role of forensic pathologists in veterinary forensic medicine. *Forensic science medicine and pathology.* 2011. Vol. 7. Is. 3. Pp. 231—232. DOI: 10.1007/s12024-011-9241-x (date accessed: 20.02.2022).

14 Щербаковський М. Г. Проведення та використання судових експертиз у кримінальному провадженні : монографія. Харків, 2015. 560 с.

15 Ottinger T., Rasmusson B., Segerstad C. H. A., Merck M., Goot F. V. D., Olsen L., Gavier-Widen D. Op. cit.

*analytical (*separate research*), comparative, synthesizing (evaluation).*

The phasing of the expert study reflects not only the procedure of expert knowledge of the properties of forensic veterinary examination objects, but also allows to trace the process of examination and evaluate the results obtained during the analysis of the expert conclusion. Each stage of expert examination of animal carcasses performs certain functions and provides solutions to intermediate tasks.

The division of the process of forensic veterinary examination into separate stages is due to various techniques, as well as those tasks that the specialist solves in the process of diagnostic forensic veterinary examination of the animal carcass [16]. The commonality of the stages reflects general points characteristic of any expert research as one of the varieties of forms of cognition. The variety lies in the part and number of same-named stages in the structure of diagnostic studies.

The sequence of application stages of expert research in forensic veterinary examination of animal carcasses makes it possible to logically explain the pathomorphological changes found in the animal carcass, and on the basis of their comprehensive assessment to formulate forensic veterinary diagnosis and final conclusions based on expert research [17]. During the forensic veterinary examination, the expert uses special methods and technical means to help identify hidden information in the object of study, which has probative value [18]. Consider in more detail the stages of forensic veterinary examination of animal carcasses.

1. Preparatory stage of expert research

At the first, preparatory stage of expert research, the forensic veterinary expert gets acquainted with the document on appointment of examination, and also the objects (material and materialized) provided for examination. The main task of the expert at this stage is to find out the complete list of objects submitted for examination, to establish compliance of materials and objects received by the expert institution (expert) with the information specified in the procedural document on appointment of forensic veterinary examination, and to make the scheme of the decision of the tasks set before him. At this stage of examination, the expert solves certain tasks related to the study of the document on the appointment of forensic veterinary examination or the involvement of an expert; establishes the category of the case for which the forensic veterinary examination is assigned; studies the list of objects subject to forensic veterinary examination; finds out the method of delivery of the animal's carcass and other materials, the type of packaging (its nature and integrity), the name of the received documents and the number of sheets in them; checks the availability of information in the case file to identify the expert initiative. These data are extremely important for the choice of methods of forensic veterinary examination and evaluation of the results obtained during the examination. At this stage, the expert

16 Ribas L. M., Massad M. Rr., Pinto A. C., Heng H. G., Tremori T. M., Reis S. T., Baroni C. O., Massad E., Rocha N. S. Post-mortem CT vs necropsy in feline medicine. *Journal of Feline Medicine and Surgery*. 2020. Vol. 22. Is. 12. 1206—1213. DOI: 10.1177/1098612X20919310 (date accessed: 20.02.2022).

17 Mangematin G. Op. cit.

18 Parry N. M. A., Stoll A. The rise of veterinary forensics. *Forensic Science International*. 2020. Vol. 306. Art. 110069. DOI: 10.1016/j.forsciint.2019.110069 (date accessed: 02.05.2022).

finds out the subject of forensic veterinary examination, implemented in the tasks and fundamental for further examination, as well as the relationship of the object with the subject of forensic veterinary examination. After that, the forensic expert, if necessary, formulates a request for additional materials, information, samples; selects regulations, methods and sources of special literature, which will be used during the forensic veterinary examination and draws up a scheme of further examination.

Thus, at the preparatory stage of the expert examination, the expert forms a program of forensic veterinary examination of the animal's carcass, which regulates the content and procedure in sequence, which ensures the solution of a specific expert task.

2. Analytical stage of expert research (separate research)

At this stage, the expert conducts the examination of each object of forensic veterinary examination separately or individual components of one object (for example, describes in detail, removes, records, analyzes individual organs, parts of organs or parts of an animal carcass) that are important for binding of the set expert tasks.

The carcass of an animal provided for forensic veterinary examination is material evidence in the case. Carrying out its forensic veterinary examination is always accompanied by a violation of the anatomical integrity of tissues, organs, parts of the body. Therefore (according to pgh. 4.11 of the Instruction on the appointment and conduct of forensic examinations and expert research [19], hereinafter referred to as the *profile instruction*) in the procedural document on appointment of forensic veterinary examination there should be the permission for application of destructive research methods; if such permission is not available in this document, the damage to the animal's carcass must be accompanied by the written consent of the authority or person who appointed the forensic veterinary examination or involved the expert.

Registration and anamnestic data, external and internal signs of an animal carcass, results of additional instrumental and laboratory examinations are subject to expert research (fig. 1).

Examining the registration and anamnestic data of the animal's carcass, establish: the location of the carcass before autopsy; its physique, consistency, fatness, the degree of cadaveric cooling and hardening, the severity of signs of decay; the condition of the visible part of the mucous membranes, hair, skin, oral and nasal cavities, available for external examination; condition of the eyes, auricles, neck, anus, external genitalia, thoracic and pelvic limbs, spine and head, assessing their development and integrity to the touch.

During the internal examination of the animal's carcass at the analytical stage of the expert examination pay attention to the condition of the subcutaneous fat layer, assess the condition of the cavities of the animal's carcass (presence of foreign odor, condition of serous membranes); humidity, relief, color, transparency, layers, adhesions, filling of blood vessels, hemorrhages and their localization; thickening, adhesions with organs).

In the head area, the organs of the oral cavity, nose, eyes, ears, soft tissues and bones, the brain and its membranes, lymph nodes, salivary glands, and

19 Інструкція про призначення та проведення судових експертиз ... . URL: https://zakon.rada.gov.ua/laws/show/z0705-98#Text (date accessed: 20.02.2022).

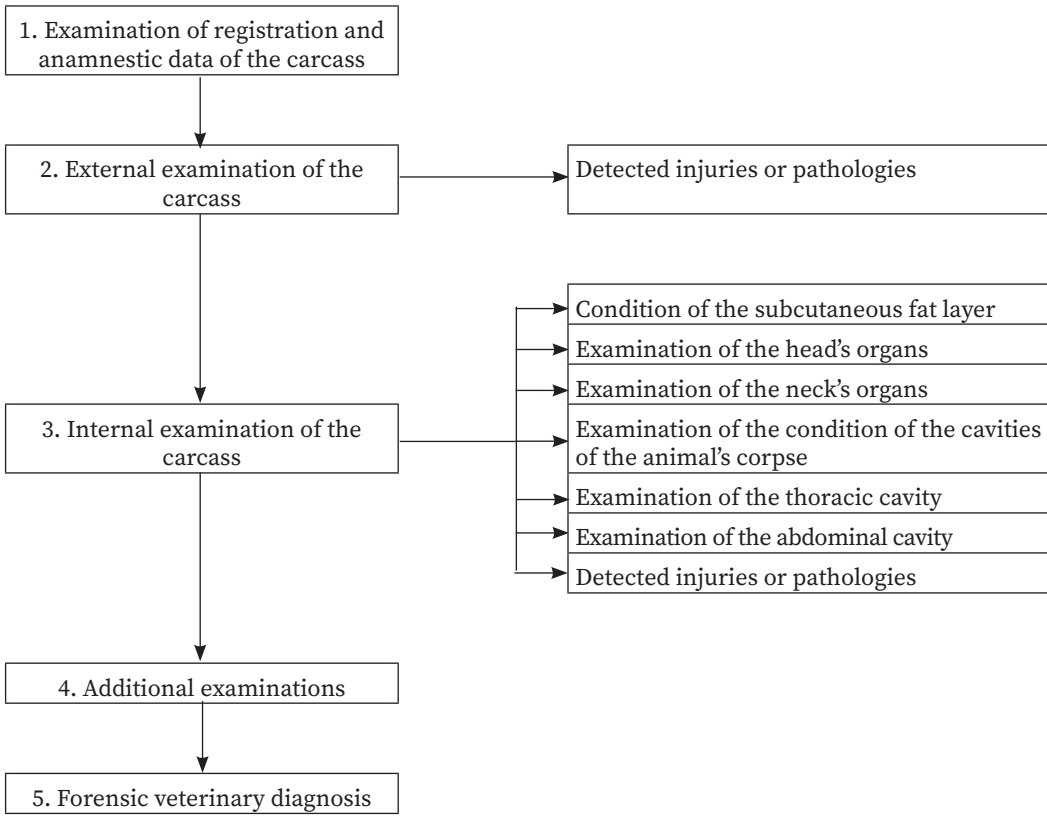

Fig. 1. Block diagram *"Forensic veterinary examination of the animal's carcass"*

paranasal sinuses are subject to mandatory examination. In the neck area, soft tissues, cervical part of the esophagus and trachea, thyroid gland, cervical part of the thymus, large blood vessels (carotid arteries and jugular veins), vagosympathetic trunk are subject to mandatory examination.

Then conduct research on at least three cavities of the carcass — thoracic, abdominal, pelvic and cerebral, as well as organs located in them. In the thoracic cavity of the animal carcass must examine the pleura, heart with pericardial sac, large blood vessels, lungs, bronchi, thoracic trachea and esophagus, thoracic thymus.

In the abdominal cavity of the animal's carcass examine the peritoneum, diaphragm, spleen, liver with gallbladder, pancreas, kidneys, adrenal glands, stomach, large omentum, intestines, in males (testicles with appendages, vas deferens and urethra), in females (ovaries, fallopian tubes, uterus, genitourinary sinus), large blood vessels. The forensic veterinary expert must pay attention to the position of the organs in the body cavities and the position of the dome of the diaphragm.

In addition, examining each organ separately, also assess its external

condition and the condition of the incision. Examination of parenchymal organs (lungs, liver, kidneys, spleen, pancreas, adrenal glands, thyroid gland, ovaries, testes, etc.) are carried out in the following order: 1) external signs — shape, color, consistency, size of the organ, linear dimensions, mass; and 2) internal signs — the state of the parenchyma during incision of the capsule; capsule condition; the condition of the body's tissues in section.

Examination of tubular organs (esophagus, larynx, trachea, stomach, intestines, bladder, fallopian tubes, vas deferens, uterus, etc.) are carried out similarly: first describe the external (shape, color, humidity, etc.) and internal signs (organ content, mucosal condition and muscle membranes, the degree of blood supply to the vessels of the organ wall).

Each organ removed from the above cavities of the animal's carcass shall be described in accordance with the procedure established in forensic veterinary practice. For example, the description of the heart contains the following parameters: anatomical position (anatomically natural or displaced); the pericardium is separated or not separated from the heart, anatomically intact or damaged; the contents of the pericardial cavity (absent, containing fluid (indicate the volume in cm^3)); the nature of the contents (yellowish, red liquid, fibrin film); shape (conical or other); myocardial size (unchanged, slightly enlarged, markedly enlarged, reduced); weight (indicated in grams); dimensions (indicate linear indicators of length, width, thickness in centimeters); the apex of the heart (blunt, pointed); coronary arteries of the heart (tortuous or not tortuous, narrowed or not narrowed); epicard (shiny, dull; wet, dry; smooth, rough; without overlays or with overlays of fibrin; without or with hemorrhages in the form of small hematomas, with hemorrhages of spotted appearance (Tarde's spots)); pidepicardial fat (well expressed, moderate, absent, contains infiltrates); left ventricular cavity (unchanged, dilated or thinned; contains liquid uncoagulated blood, red blood clots, white blood clots, mixed blood clots); left ventricular wall (unchanged, thickened, thinned); the cavity of the right ventricle (unchanged, dilated, thinned; contains liquid uncoagulated blood, contains red blood clots, contains white blood clots, contains mixed blood clots); the wall of the right ventricle (unchanged, thickened, thinned); the ratio of the chambers of the heart (defined as 2:1 or 3:1); blood in the chambers of the heart (sat evenly, did not sit down; settled more in the right or left ventricles; color of seats: red, purple, chocolate, white); endocardium (light gray, gray; smooth, rough; shiny, dull; no hemorrhage, spotted hemorrhage (Minakov's spots), expressed in the valves in the form of small hematomas); endocardiosis (severe or absent); myocardial color (red, dark red, light red, yellow-brown, brown, with white layers, grayish-red, gray, spotted gray); humidity (dry, wet); consistency (elastic, flabby, dense); crescent valves (thin, thickened, diffusely thickened; compacted, flabby; with or without sclerotic plaques; smooth, rough; transparent, translucent, matte); three-and two-leaf valves (thin, thickened, diffusely thickened; compacted, flabby; with or without sclerotic plaques; smooth, rough; transparent, translucent, matte); chordal threads (not changed, shortened, stretched, with unchanged thickness, thickened, thinned); aorta (diameter: unchanged, enlarged, narrowed); sclerotic plaques (pronounced or absent); transverse tears of the intima (expressed or absent); color (dark red or light red);

the surface of the inner shell (smooth or rough); the width of the vessels above the valves (indicate the width of the aorta and pulmonary artery in centimeters); large blood vessels (consistency of blood in them: liquid, red, white or mixed); intima surface (smooth or rough); transverse tears of the intima (expressed or absent); intimacy color (dark red or light red); damage (absent or detected: indicate the area and their nature).

As a result of a separate study, two sets of features are distinguished: *general* (without pathomorphological changes) and *individual* (with pathomorphological changes that characterize the organ or body part of the animal's carcass, to an extent sufficient for diagnostic purposes).

For example, in the case of mechanical asphyxia in a cat from the compression of the neck by a loop, the diagnostic signs are: single, open, unevenly indented, obliquely ascending strangulation furrow in the upper third of the neck, acute pulmonary emphysema, punctate hemorrhages in the conjunctiva and eyelids epicardium (Tarde's spots), plethora of internal organs, liquid blood. Diagnostic signs in the case of gunshot shroud blind penetrating injury of the left chest of the animal with damage to the left lung and heart: the entrance on the anterior surface of the left chest without signs of a close shot, the presence of pellet in the wound canals, left hemothorax, hemopericardium. For combined trauma in dogs, the diagnostic signs will be: penetrating stab-cut damage to the anterior surface of the chest on the left with damage to the right atrium and cranial lobe of the left lung; left hemothorax, hemopericardium. In the case of open traumatic brain injury diagnostic signs are: fragmentary fracture of the left parietal bone with damage to the dura mater, subdural hematoma, subarachnoid hemorrhage there, hemorrhage into the soft tissues of the head, massive blood loss, anemia of internal organs, weak pronounced carcass spots.

At the stage of analytical forensic veterinary research , a set of methods is widely used [20]: in particular, *general* — dialectical and logic (abstraction, analysis, induction, idealization, formalization, etc.), observation, measurement, description, hypothesis construction, planning, experiment, modeling, program-mathematical, etc.; *separate* (instrumental and auxiliary technical) — forensic photography and microphotography, radiological diagnostics, hematological and microbiological, microscopy, mass spectroscopy, etc.); *special* — the functions of which are performed by specialized (specific) methods of solving specific expert tasks.

At the analytical stage of forensic veterinary examination of the animal carcass, the expert also uses various technical means: as *simple devices* (measuring ruler (in particular, metal), magnifier, microscopes for various functional purposes, scales, ultraviolet and infrared light source, camera, tape measure, measuring cylinders for determining the amount of liquid, scales for weighing organs, glasses made of ordinary glass for eye protection) and *tools* (large sectional knives; dissecting knives such as surgical abdominal scalpels; cartilaginous and cerebral knives; scissors: intestinal and button, with pointed ends (dissecting) for opening small blood vessels and ducts;

20 Яценко І., Сімакова-Єфремян Е., Дереча Л. Методи судової експертизи та їх застосування у судово-ветеринарних дослідженнях. [Forensic expertise methods and their application in forensic veterinary research] *Теорія та практика судової експертизи і криміналістики*. 2021. Вип. 2 (24). С. 52—76. DOI: 10.32353/khrife.2.2021.04 (date accessed: 20.02.2022).

knives: sectional, costal, bone, coopers, cerebral intestinal, bent at an angle (for blood vessels and canals) and button; bone forceps; hammer with blade; saws: bucksaw, double (from two parallel cloths for opening of the spinal canal at carcasses of small animals), sheet for deep cuts of bones, double; chisel; scalpels, tweezers: toothed and anatomical; probes (button and grooved); chisel; rickets — a chisel for opening the spinal canal; hammers (steel and wooden); clamps for fixing the bones extracted from the carcass during their sawing; spoons of different sizes to drain the fluid from the cavities of the carcass; two-toothed hooks; injection syringes; trepan; vise for fixing a detached head and bones; ditches; this one; sideburns; glassware for pathological material, glass bottles) and *sophisticated analytical equipment* X-ray machine, apparatus for ultrasonographic examination, devices for spectral analysis, mass spectrometers, chromatographic analyzers, biochemical blood analyzer, microscopes, etc.). At this stage, the expert uses the methods and means of forensic veterinary examination not only to identify signs, but also to record them.

In the process of forensic veterinary autopsy of the animal's carcass, the expert removes pieces of individual organs, tissues, biological fluids for additional instrumental and laboratory tests (including forensic toxicology, forensic chemistry, forensic histology, forensic immunology, microbiological, parasitological, forensic, etc.). Sometimes it is necessary to conduct instrumental radiological and other visualization methods of examination of the carcass [21].

Various foreign inclusions in the animal's carcass (particles of metal, glass, wood, mineral oils, soot, grains of gunpowder (in case of gunshot wounds), dirt, etc.) can get into the areas of damage from the contact surface of the weapon. Their detection in the areas of damage contributes to the specification of expert conclusions on injuries and the mechanism of action of traumatic weapons. Thus, traces of metals in the area of damage can be detected using color prints, color chemical reactions and spectral emission analysis.

Additional methods of forensic veterinary examination can detect glass fragments, which may indicate injury to the glass or the tool that contains it (in particular, the relevant parts of vehicles). For this purpose, the method of direct microscopy (magnification 8—12 ×), radiography in soft rays, centrifugation of washes with distilled water of the damaged area with simultaneous scraping with a scalpel, color test with cresol red, and stereomicroscopy are used.

When inspecting the area of damage with the naked eye or during stereomicroscopy, you can see such foreign inclusions as wood particles, soot, gunpowder grains, and so on.

Mineral oils in the area of damage can be detected in the case of traffic injuries (e.g., traces of lubricants), gunshot wounds (gunpowder and sediment in the area of the inlet). They detect them by the characteristic luminescence in ultraviolet rays. Gas-liquid chromatography is a highly sensitive and accurate method of detecting and differentiating different mineral oils.

21 Grela M., Listos, P., Gryzinska M., Chagowski W., Buszewicz G., Teresinski G. (2018). Imaging techniques as a method of sectional examination in forensic veterinary medicine. *Medycyna weterynaryjna*. 2018. Vol. 74. Is. 12. Pp. 751—758. DOI: 10.21521/mw.6005 (date accessed: 20.02.2022).

Sooty shot can be detected by photographing the object in infrared rays on special photographic plates and films. Since smokeless soot contains mostly metals of copper, lead, antimony, tin, iron, the method of color prints, as well as emission spectral analysis are used to detect them.

Soot and gunpowder grains can be detected during histological examination of the area of the inlet on the body skin and the walls of the wound canal. The grains of smokeless powder in the histological preparation have the form of translucent fibrous masses of greenish-gray or yellowish-gray color, round, oval or elongated shape with clear contours, but can also be in the form of small shapeless particles. Gunpowder grains are black particles.

Often the special knowledge and professional competencies of a forensic veterinary expert are not enough to solve some expert tasks, so a comprehensive examination is prescribed — for example, forensic veterinary and forensic ballistic examinations, forensic veterinary and forensic biological examinations, etc.

Based on the analysis of each detected pathomorphological feature of the animal carcass, the forensic veterinary expert identifies a set of specific pathognomonic features and decides on their suitability for solving diagnostic expert tasks.

During a comprehensive examination [22] of animal cruelty (for example, forensic veterinary and forensic ballistic) the choice of general research methodology is complicated: because the techniques used by forensic veterinary experts should not prevent the study of the same object (animal carcass) to an expert of another profile — for example, a ballistic expert.

After the forensic veterinary examination of objects (animal carcasses or their fragments) received by the expert institution, examination of case materials (rulings, court rulings) and questions referred to the expert, the forensic veterinary expert puts forward expert versions. The expert version (hypothesis) is a reasonable assumption of the expert about the properties and condition of the provided objects (animal carcasses or their remains), the final and intermediate circumstances to be established during the forensic veterinary examination. Expert versions can be general, i.e. to solve the problem in general (for example, determining the cause of death of the animal) and individual, which solve intermediate expert tasks (for example, to determine the nature of fatal injuries, their location, survival or mortality, mechanism, sequence, age of infliction, severity of injuries found in the carcass of the animal, the characteristics of the animal's carcass, which can establish the nature and characteristics of weapons or other weapons, which caused injuries, etc.).

Expert versions put forward various causes of the animal death, in particular the category of death (violent — from the effects of certain actions or circumstances on the body, when this effect causes a condition incompatible with life [23], or nonviolent death — death from exposure to pathogenic factors, the occurrence of which is not associated with acts of violence [24]), childbirth (natural; sudden —

22 Сімакова-Єфремян Е. Б. Теоретико-правові та методологічні засади комплексних судово-експертних досліджень : дис. … д-ра юрид. наук. Харків, 2017. 503 с.

23 Beirne P. For a nonspeciesist criminology: Animal abuse as an object of study. *Criminology*. 2006. Vol. 37. Is. 1. Pp. 117—148. DOI: 10.1111/j.1745-9125.1999.tb00481.x (date accessed: 20.02.2022).

24 Piegari G., Cardillo L., Alfano F., Vangone L., Iovane V., Fusco G.. Pathological, Bacteriological and Virological Findings in Sudden and Unexpected Deaths in Young Dogs. *Animals.* 2020. Vol. 10. Is. 7. P. 1134. DOI: 10.3390/ani10071134 (date accessed: 20.02.2022).

death without clinical signs of disease, which occurs unexpectedly, suddenly in a clinically healthy body; accident — death due to injuries caused unintentionally, as well as a result of natural disasters, accidents and catastrophes, both natural and man-made character [25]), types of death (from mechanical injuries [26], from mechanical asphyxia [27], from changes in barometric pressure [28], from high or low temperature [29], from electricity [30], from radiant energy [31], from poisoning [32]).

Expert versions can also be put forward regarding the age of death of the animal, death at the scene, movement of the carcass in space after death [33], survival or postmortem occurrence, mechanism, sequence, age of bodily injury found in the carcass; the nature and features of weapons or other weapons that have caused bodily harm on the characteristics of the carcass, etc. [34].

Without the design, development, verification, refinement, final acceptance of the expert version until the transition from the hypothesis (assumption) to a reliable, truthful conclusion, the solution of problems in forensic veterinary examination is impossible. You should submit at least two versions. For example, when solving a diagnostic expert task, the *first version* — the damage occurred from the fall of an animal from a height, the *second version* — the damage is the result of a collision with a moving vehicle; the detected wound hole on the carcass was formed by the action of a prickly object or by the action of a high-velocity kinetic projectile, which could be a bullet.

At this stage, the forensic veterinary expert plans the sequence of forensic veterinary examination of the animal's carcass, taking into account the proposed expert versions: draws up

25 Rowden P., Steinhardt D., Sheehan M. Road crashes involving animals in Australia. *Accident Analysis and Prevention.* 2008. Vol. 40. Is. 6. Pp. 1865—1871. DOI: 10.1016/j.aap.2008.08.002 (date accessed: 20.02.2022).

26 Ressel L., Hetzel U., Ricci E. Blunt Force Trauma in Veterinary Forensic Pathology. *Veterinary Pathology*. 2016. Vol. 53. Is. 5. Pp. 941—961. DOI: 10.1177/0300985816653988 (date accessed: 20.02.2022).

27 McEwen B. J. Nondrowning Asphyxia in Veterinary Forensic Pathology: Suffocation, Strangulation, and Mechanical Asphyxia. *Ibid*. Pp. 1037—1048. DOI: 10.1177/0300985816643370 (date accessed: 20.02.2022).

28 Bruchim Y., Loeb E., Saragusty J., Aroch I. Pathological Findings in Dogs with Fatal Heatstroke. *Journal of Comparative Pathology.* 2009. Vol. 140. Is. 2—3. Pp. 97—104. DOI: 10.1016/j.jcpa.2008.07.011 (date accessed: 20.02.2022).

29 Gwaltney-Brant S. M. Veterinary Forensic Toxicology. *Veterinary Pathology*. 2016. Vol. 53. Is. 5. Pp. 1067—1077. DOI: 10.1177/0300985816641994 (date accessed: 20.02.2022).

30 Touroo R., Fitch A. Identification, Collection, and Preservation of Veterinary Forensic Evidence: On Scene and During the Postmortem Examination. *Ibid*. Pp. 880—887. DOI: 10.1177/0300985816641175 (date accessed: 20.02.2022).

31 Siqueira A. de, Cassiano F. C., Landi M. F. D., Marlet E. F., Maiorka P. C. Non-accidental injuries found in necropsies of domestic cats: a review of 191 cases. *Journal of Feline Medicine and Surgery.* 2012. Vol. 14. Is. 10. Pp. 723—728. DOI: 10.1177/1098612X12451374 (date accessed: 20.02.2022).

32 Gwaltney-Brant S. M. Op. cit. DOI: 10.1177/0300985816641994 (date accessed: 20.02.2022).

33 Touroo R., Fitch A. Op. cit. DOI: 10.1177/0300985816641175 (date accessed: 20.02.2022).

34 Siqueira A. de, Cassiano F. C., Landi M. F. D., Marlet E. F., Maiorka P. C. Op. cit. DOI: 10.1177/1098612X12451374 (date accessed: 20.02.2022).

a work plan, outlines the scope and nature of the examination, selects the necessary methodology, containing methods, techniques and tools terms of the beginning and the end of forensic veterinary examination.

When choosing a method, it is necessary to take into account the requirements for the methods of forensic veterinary examination, in particular: scientific validity and reliability; approbation, obviousness and clarity of the results of application of these methods for all participants of the process; adherence to moral and ethical principles and efficiency; verifiability and security; simplicity and accessibility; relevance and universality; admissibility and maximum preservation of research objects.

Expert tasks are solved in three ways: *algorithmic, heuristic*, and *mixed* (combination of the previous two).

The algorithmic way in forensic veterinary examination is suitable for standard and typical expert tasks that involve the use of standard solutions, and is typical for solving typical issues related to the objects most common in forensic veterinary examination (in particular, animal carcasses).

An example of such a typical technique is the method of forensic veterinary autopsy to determine the cause of death. The carcass of the animal is to be examined. During the forensic veterinary autopsy, it was established that specific pathomorphological features that characterize the changes in the animal's body that are incompatible with life are the gross anatomical destruction of the skull bones and the substance of the brain. This uses the macroscopic method of analysis. The pathomorphological changes found in the carcass together allow to determine the location, nature, sequence of injuries and the mechanism of their infliction, as a result — to answer the question posed in the document on the appointment of forensic veterinary examination.

Ways to solve non-standard expert tasks, which are not described in the standard expert methods, the expert develops independently during the implementation of a specific forensic veterinary examination. When setting such tasks, the heuristic technique is predicted by the specialist at the preparatory stage of the examination.

The choice of the method of solving the diagnostic forensic veterinary task is determined by the nature and peculiarity of the objects provided for forensic veterinary examination. Objects (animal carcasses), as well as the initial data that are the basis for diagnosis, can be different informative (*sufficiently informative* — with a wide field of information features, *informative* — with a sufficient field of information features, *uninformative* — with a narrow field of information features, *non*-informative — in the absence of information signs).

Upon completion of the analytical examination, the forensic veterinary expert concludes that the set of symptoms is sufficient or insufficient to make a forensic veterinary diagnosis. The conclusions made at the analytical stage are supplemented by the specialist in comparative and synthesizing examinations.

At the analytical stage of forensic veterinary examination of the animal's carcass during the solution of the diagnostic expert task, the expert experiment is not used.

Analysis and synthesis of features obtained as a result of analytical (separate) research allows for a full comparative examination.

3. Comparative stage of expert research

The main task of this stage is to compare, determine the coincidences or discrepancies found during a separate examination of the complexes of features of the studied objects, and if there are differences — to establish their cause and determine whether they are natural and significant or accidental.

Analytical and comparative research are interdependent. The comparison procedure is carried out on the basis of the features established during a separate examination of the animal carcass. For its part, the task, the object and the direction of the separate study are entirely determined by the purpose of this stage: the preparation of a comparative examination. The properties and signs (pathomorphological changes) of the object (animal carcass) isolated and examined at the analytical stage are compared with the well-known normal structure of organs and tissues.

Comparative research during diagnostic forensic veterinary examination has its own specifics. First, by comparing the normal structure of an organ or tissue and the pathologically altered structure of those organs and tissues. Secondly, to make a forensic veterinary diagnosis based on the results of the study of the animal's carcass is possible only as a result of a comparative research of a set of diagnostic specific (pathognomonic) signs.

At this stage, the method of comparison prevails. When comparing objects based on the results of quantitative determination of the composition and structure of their material, methods of mathematical statistics of measurement results are used. This stage is completed by establishing the coincidences and differences of the features of the compared objects.

After analyzing all the results of the examination (forensic veterinary autopsy, instrumental and laboratory additional research), regardless of the tasks to be solved during the forensic veterinary examination, the expert formulates a forensic veterinary diagnosis. Summarizing the theoretical data of the scientific literature, our own research and many years of practical experience, we propose to define a ***forensic veterinary diagnosis*** as a conclusion formulated by a forensic veterinary expert based on a comprehensive examination of an animal carcass on the nature of the essence of the disease and / or trauma, reflecting the nosology, etiology, pathogenesis and mechanism of such disease and / or injury (according to veterinary terminology).

The formulation and construction of the forensic veterinary diagnosis makes it possible to summarize the main and important points identified during the examination of an animal carcass, shows the relationship between the cause of death and injury, or poisoning, or disease, and further facilitates the preparation of substantiated expert conclusions based on the results of forensic veterinary examination of the animal's carcass with signs of violent or sudden death.

The logical and consistent formulation of the forensic veterinary diagnosis testifies to the high professional level of the forensic veterinary expert and helps to compare the results of lifelong clinical examination of the animal with the results of forensic veterinary examination of the carcass in case of death.

Forensic veterinary diagnosis allows the person who appointed the examination, as well as the court to better accept the conclusions, to obtain a complete picture

of the nature of the injuries or diseases that led to the death of the animal and established during the forensic autopsy of the carcass. The diagnosis helps more precisely formulate the cause of death and justify it, structure the descriptive part and facilitate the expert's conclusion.

Forensic veterinary diagnosis is morphological. It is based on morphological detection of pathological processes. The main task of the forensic veterinary expert is to determine the main and immediate cause of the animal death. A necessary condition for this is the obligatory etiopathogenetic connection between the detected pathomorphological changes of the animal (in case of bodily injuries or diseases) and its death, which are reflected in the forensic veterinary diagnosis.

For forensic veterinary diagnosis, its three-member, rubricized structure is generally accepted. *Headings of forensic veterinary diagnosis* its sections for fixing the main injury or disease, complication of the main injury or disease, combined, concomitant and background injuries or diseases in the form of nosological units. *Nosological unit* — a specific disease or injury, poisoning or condition, identified on the basis of established etiology, pathogenesis and / or mechanism as a set of features identified by clinical, laboratory and instrumental methods that allow to identify disease, injury or poisoning.

The main injury or disease is the nosological unit with the most pronounced manifestations, which caused death of the animal (for example, compression of the brain by a growing hematoma, for traumatic brain injury). The main nosological unit of a disease, injury, poisoning or condition can by itself (without development complications) lead to death, as well as become both primary and immediate cause of death. Such nosological units are considered primarily: mechanical trauma, incompatible with life (for example, traumatic separation of the head from the torso, gross destruction of the brain, etc.), acute poisoning by toxic substances (e.g., potent pharmaceutical substances, etc.), various types of mechanical asphyxia loop, etc.), electric shock (for example, lightning or industrial electricity), the action of extreme temperatures (e.g., general hypothermia, and so on), etc.

Complications of the main injury or disease are nosological units, more often symptoms and syndromes, which are directly or indirectly related to the main injury or disease, but are not its detection. Complications of the main injury or disease are the closest ones that occurred immediately after the injury or at the beginning of the disease (for example, heavy blood loss, embolism, etc.); distant, developed in the late period of illness or injury (for example, pneumonia, sepsis, peritonitis, etc.); the main ones that are leading in the development of injury or illness and have become decisive in the onset of death of the animal. The main complication is the cause of death.

Concomitant injury or disease is one or more nosological units directly related to the underlying disease or injury and involved in the mechanism of death. They can be formed both before and after the main injury or disease and are not directly causally related to the onset of death.

Competing injuries or diseases are nosological forms that the animal has suffered from during its lifetime, and each of them individually, by itself or due to its complications, could lead to death. Examples of such diseases are any serious fatal illnesses and injuries that coincide

in time in one sick animal (for example: severe traumatic brain injury with bruising of the brain and stab wounds with signs of massive blood loss; incompatible with life cerebral infarction and myocardial infarction, severe traumatic brain injury and stab wound with damage to a large blood vessel, etc.).

Combined injuries or diseases are those in which a dead animal has suffered at the same time and which, by mutually aggravating each other, have resulted in death, each of which has not been fatal (e.g., fracture of several ribs and chronic obstructive pulmonary disease with respiratory failure). It is important to note that competing or combined diseases are nosological forms that occur simultaneously and not sequentially.

Background injury or disease is one that is not etiologically related to the underlying injury or disease, but pathogenetically significantly exacerbates the underlying disease (e.g., adverse trauma in animals with severe diabetes mellitus: diabetes mellitus often causes secondary immune deficiency, becomes a background disease for many infectious diseases).

The immediate cause of death is an injury or illness or its complications, which became the final manifestation in a chain of pathological processes that directly caused the death of the animal (e.g., gross destruction of the animal's body, vital organs, etc.), or nearby complications (e.g., significant blood loss, embolism, etc.), or distant complications (e.g., pneumonia, sepsis, peritonitis, etc.).

Forensic veterinary diagnosis is formed concisely, clearly, completely, accurately, with the formulation of pathomorphological changes arranged in a logical sequence, taking into account the pathogenetic principle, with the definition of the underlying disease and the processes that accompany it, which is the basis of expert conclusion.

Forensic veterinary diagnosis confirms, clarifies or expands the clinical diagnosis (in case of death of the animal during treatment). Diagnosis is not a conclusion, it only contributes to the correct, consistent and reasonable drawing of conclusions. If the results of laboratory tests are necessary for the formulation of the diagnosis, it is made out after their receipt.

The wording of the forensic veterinary diagnosis is unregulated. The diagnosis does not explain or substantiate anything, but it must be complete, i.e., it must contain all pathomorphological changes or injuries detected by the forensic veterinarian during the autopsy of the animal. In this case, homogeneous injuries, diseases or conditions combine.

Forensic veterinary diagnosis is based on nosological and pathogenetic principles, reflecting the sequence of development of the detected changes. The most important are its components — the main disease (injury), its complications, concomitant and background diseases or injuries.

Sometimes the forensic veterinarian cannot prove and explain the cause of the animal's death. In this case, he declares the impossibility of establishing the cause of death and states why (for example, due to severe signs of decay of the carcass or its skeleton, etc.).

On the basis of special veterinary knowledge, the expert must analyze the results of intermediate expert studies and give an expert assessment. To do this, it is necessary to move to the next stage, which is the evaluation of research results, summarizing their results and formulating conclusions.

4. Synthesizing stage
(evaluation stage of the expert research)

The final stage of expert research is the most responsible for forensic veterinary examination, because the expert gives the final conclusion and determines the weight of all signs identified at the analytical stage of diagnostic research, their diagnostic informativeness, identified in the comparative study, forms an intermediate expert opinion on the results. research. The synthesizing stage of expert research completes the process of forensic veterinary examination, and its content is the generalization and aggregate expert evaluation of the results of individual studies, based on methods of formal logic (analysis, synthesis, deduction, induction) and their inner convictions, which are the basis for conclusions [35]. The results of this stage are presented in the synthesizing section of the research part of the expert's opinion, so it is also called synthesizing.

Expert evaluation at the stage of synthesis is characterized by the following features:

- it is final, determines the necessary (minimum) and sufficient (maximum) basis for the expert's conclusion, which determines its form and content;
- concerns a set of pathomorphological changes in the animal's carcass, and not individual features detected at the stage of separate examination in individual organs, tissues or parts of the body;
- the expert evaluates not individual identified pathological changes in organs and tissues, but their totality, given the informativeness of each, i.e. has an integrative nature.

In contrast to the evaluation of individual pathomorphological features found in the animal's carcass to solve intermediate tasks at individual stages of expert research, expert evaluation in the final stage covers the whole set of established pathognomonic changes detected in the animal carcass, the results of additional instrumental and laboratory studies, results research of case materials: it is carried out to solve the tasks set in the document on the appointment of forensic veterinary examination.

The pathomorphological signs found in the animal's carcass are evaluated in the following sequence: 1) the main injury or disease that led to the death of the animal; 2) complications of the main injury or disease; 3) competing, concomitant and background injuries or diseases.

Evaluation should begin with an indication of the species of the experimental animal's carcass; sex, age and physiological characteristics; analysis of the revealed pathomorphological pathognomonic changes in organs and tissues, which became the basis for forensic veterinary diagnosis. Expert assessment of these changes involves a scientific explanation of their nature: the specialist notes the identified injuries, their location, survival or mortality, sequence, pathogenetic mechanisms of occurrence (infliction), the nature of the injury that could have caused the injury, cause and effect between injury and death

35 Осипенко І. П., Пророченко В. В. Висновок експерта в досудовому розслідуванні. *Юридичний науковий електронний журнал*. 2020. № 2. С. 339—402. DOI: 10.32782/2524-0374/2020-2/104 (date accessed: 20.02.2022).

of the animal. For this purpose, the information reflected in case materials and belongs to a subject of research acquires special value.

At the stage of evaluating the results of forensic veterinary examination of an animal carcass in forensic veterinary examination it is advisable to apply objective conditions (criteria) of evaluation. For example, in diagnostic researches of visible mucous membranes consider: integrity (not broken, broken — mark a site); color (pale pink, pale gray, pale, jaundiced, cyanotic, pigmented); humidity (expressed well, moderately, absent); inflammation (absent, catarrhal, purulent, purulent-catarrhal, hemorrhagic); damages (absent, registered — indicate the area of distribution and their nature); the presence on the surface of mucus, erosions, ulcers, exudate (fibrinous, purulent, etc.), as well as hemorrhage, atrophy (thinning) or hypertrophy (thickening). There are criteria for describing other organs and parts of the body.

To automate the registration and analysis of individual pathomorphological features of the animal's carcass, you can use computer programs, in particular, developed by us information and expert system "Forensic Veterinary Section".

At the stage of expert evaluation of the results of diagnostic forensic veterinary examination of the anima's corpse and the formation of conclusions, when there is a transition from hypothesis to reliable judgment, the specialist survival or post-mortem infliction, time of injury, causal relationship between the nature of the injury and the death of the animal, the rate of death of the animal after injury, the animal's pain and suffering from the damage. The explanation of the existing deviations (variability) of the situation (for example, background and concomitant diseases or injuries), which do not affect the reliability of the diagnostic conclusion, should be provided here.

An important question to be answered by a forensic veterinarian is the time of infliction of fatal injury to the animal. If in the course of the forensic veterinary examination a sufficient number of pathomorphological signs characterizing the age of the animal's death is established, the expert has the right to state that the death of the examined animal occurred at the time and under the circumstances specified in the forensic veterinary examination.

In order to confirm the objectivity of the expert's conclusion based on the results of the forensic veterinary examination and substantiate the obtained results, the expert must indicate in the conclusion that there is a direct necessary causal link between the animal's injuries and death.

When deciding whether an animal has experienced pain and suffering from injuries, the forensic veterinary expert should consider the nature and number of injuries, their location, take into account the vital importance of the damaged organ or body part, and so on. Thus, in the case of causing non-life-threatening damage to an animal, when death could occur instantly, the expert first notes that the death of such an animal occurred fairly quickly (immediately), immediately after the injury, so the animal felt pain for a short time. In the case of infliction of non-life-threatening injury to an animal, when the death did not occur immediately after its injury, the expert notes that before death the animal felt pain and suffered from bodily injuries.

In the final part of the conclusion, the expert provides information on exactly how, for what reasons and in what sequence the changes related to the event of the crime took place.

When solving diagnostic expert tasks, the stage of expert evaluation is characterized by a variation of alternatives, the choice of one, the most reliable set of informative features. In particular, among the set of pathomorphological features found in an animal carcass, the most informative are pathognomonic for a particular injury or disease.

Drawing conclusions based on the results of forensic veterinary examination is a mental process that takes place in stages. The forensic veterinary expert, based on the laws and techniques of logical thinking, can return to the results of the analytical and comparative stages of the examination, their course, refer to the case file. Forensic veterinary examination is characterized by the consistent accumulation of separate, intermediate conclusions, from which follow the final conclusions, which become the answer to the questions posed in the document on the appointment of forensic veterinary examination.

"Conclusions" is the most responsible section of the final part of the expert's conclusion, which is the result of the examination of the animal's carcass, the point of the final part of the autopsy report, which concluded the cause of death, location and nature of injuries, survival or mortality, sequence of infliction, mechanism of formation, causal relationship between the nature of the injuries and the death of the animal, ascertaining whether the animal experienced pain and suffering before death, etc. If the cause of death was a disease, then indicate the underlying disease or injury, its complications, competing, comorbid and background diseases.

"Conclusions" must be complete, motivated, scientifically sound, consistently stated, clear, specific, expressive, understandable, based on factual data, avoid repetition, overload with special veterinary terms.

In the final part (results) the expert gives full and substantiated answers to the questions posed to him, set out in the court decision or resolution of the person who appointed the examination or involved a forensic veterinary expert. It is allowed to combine similar questions and change their sequence without changing the wording of the question. In the final part of the opinion, the expert may also indicate the answers to questions that the investigator did not ask, but which, in the opinion of the forensic veterinary expert, are important for the investigation (expert initiative).

At the stage of evaluation of the examination concentrated professional knowledge, practical experience of the forensic veterinary expert in the field of veterinary medicine and biology, his ability to recognize patterns of diseases or injuries identified in the carcass of an animal, on the basis of which the specialist formulates a forensic diagnosis — provides answers to the questions posed in the document on the appointment of forensic veterinary examination [36].

36 Мелех Л. В. Оцінка доказів як заключний етап процесу доказування. *Вісник Луганського державного університету внутрішніх справ імені Е. О. Дідоренка.* 2015. Т. 1. № 69. С. 132—142.

The inner conviction of the expert is the state of his consciousness, which reflects the result of mental subjective activity in the process of examination of expert assessment of factual data on a particular examination, the result of which is reflected in the expert's conclusion. Such defining features of the definition of "internal conviction of the expert" reveal its content and significance in forensic expertise, take into account the latest conditions of forensic activity, as well as state confidence in the correctness of the conclusion, i.e., compliance with reality, truthfulness, infallibility, many factors. First of all, it is based on the results of forensic autopsy of the animal's carcass, additional laboratory and instrumental studies of the material removed from the carcass and, if necessary, the study of case materials.

The expert analyzes the entire technological process of forensic veterinary examination of the animal's carcass, illustrations of the general appearance of the carcass or its individual organs and parts of the body, as well as pathognomonic changes in organs and tissues directly related to bodily injury or illness, show how clear and convincing they are for perception by a person, who appointed the forensic veterinary examination or involved a forensic veterinary expert, as well as other participants in the process, and to what extent they confirm the validity of the formulated conclusions.

Requirements for the cognitive and evaluative judgment of the forensic veterinary expert are presented in Fig. 2.

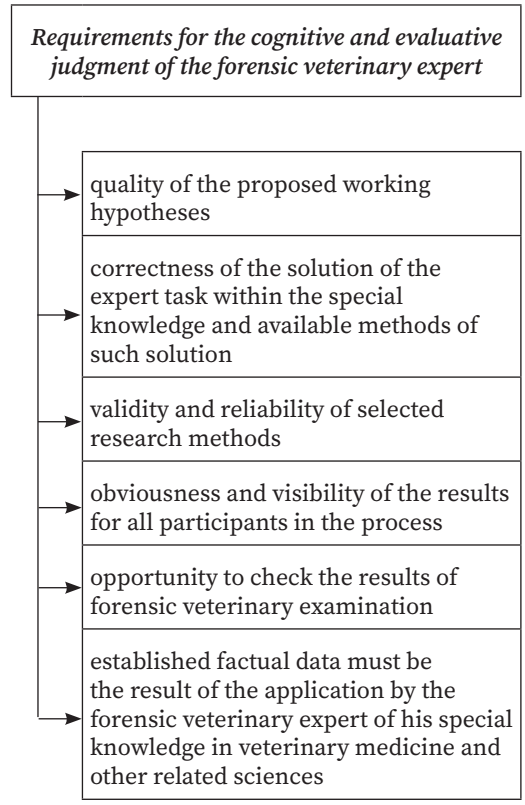

Fig. 2. Block diagram *"Requirements for the cognitive and evaluative judgment of the forensic veterinary expert"*

The formulation of conclusions takes place on two conditional levels: intermediate and final. During the forensic veterinary examination of the animal's carcass, the expert makes certain judgments about the nature of pathomorphological changes, their number, location, severity, and so on. These judgments are an intermediate conclusion [37]. After conducting a full set of expert examination (forensic veterinary autopsy, as well as additional laboratory and instrumental studies), the expert

37 Listos P., Gryzinska M., Kowalczyk M. Analysis of cases of forensic veterinary opinions produced in a research and teaching unit. *Journal of Forensic and Legal Medicine*. 2015. Vol. 36. Pp. 84—89. DOI: 10.1016/j.jflm.2015.08.002 (date accessed: 20.02.2022).

forms a general opinion (judgment) on the cause of death, location and nature of injuries, survival or postmortem formation, sequence of tasks, mechanism of formation, causal relationship between the nature of injuries and death of the animal, etc. The final nature of the assessment at the stage of synthesizing research is that it provides a basis for formulating a final expert conclusion.

In the case of a commission or comprehensive examination, the conclusion is formed according to the general rules set out in the profile Instructions, taking into account the following features:

- experts involved in conducting a comprehensive examination must have the professional knowledge necessary and sufficient to be well versed in the methodology and conclusions of other experts and to determine their significance for the overall conclusion. They should also be familiar with the method of joint implementation of a comprehensive examination, because only the interaction contributes to the integration of specialized knowledge necessary and sufficient for a comprehensive forensic veterinary examination and the formation of a joint conclusion of experts. To formulate and substantiate such a conclusion, the knowledge of one or more members of the expert commission is not enough (unlike the commission examination);
- to organize a joint research program, appoint the head of the experts (from forensic experts involved in conducting a comprehensive forensic examination);
- research conducted by individual experts describe in the relevant sections of the examination part of the expert conclusions which are signed by these experts, indicating their names and initials;
- generalization and expert evaluation of examination results are recorded in the synthesizing section of the research part of the expert conclusion, where each expert signs exactly the part that is the result of his research;
- experts involved in conducting a comprehensive examination should discuss and analyze the results of each research conducted to formulate a joint conclusion on the issues raised by the experts in the document on the appointment of a commission examination;
- if at least one expert in the complex examination has doubts about the conclusion of the other experts of this composition, he cannot individually formulate and provide the final conclusion of the experts. Such an expert may sign only the individual interim conclusions provided by him or provide a separate opinion describing the course and results of research conducted by him personally.

Thus, for the formation of the final expert conclusion is a necessary condition: in particular, the expert examination must comply with the principles of legality of the expert procedure, independence and competence of the forensic expert, scientific validity, completeness, comprehensiveness, verification,

use of all means and methods of the examination [38].

To solve the diagnostic expert task, the established set of features, which contains pathomorphological changes found in the animal's carcass, and the results of additional laboratory and instrumental research, which give the expert grounds to answer the questions posed in the document on the appointment of forensic veterinary examination, are sufficient [39].

Conclusions

In the process of any expert research, in particular forensic veterinary examination of animal carcasses, based on general methodological provisions, regardless of the tasks, there are four stages: preparatory (preliminary research), analytical (separate research), comparative, synthesizing (evaluation).

The phasing of the expert research reflects not only the procedure of knowledge of the properties of the forensic veterinary examination objects, but also allows to trace the process of examination and evaluate the results obtained during the examination of the expert's conclusion. Each stage of expert examination of animal carcasses performs certain functions and provides solutions to intermediate tasks.

The division of the process of forensic veterinary examination into separate stages is due to various techniques, as well as tasks that the specialist solves in the process of diagnostic research. The commonality of stages reflects the general points characteristic of any expert research as one of the varieties of cognition forms. The difference lies in the part and volume of the same-named stages in the structure of diagnostic research.

The application's sequence of stages of the expert research in forensic veterinary examination of animal carcasses allows logically correct analysis of pathomorphological signs found in the animal carcass, and on the basis of their comprehensive assessment to formulate forensic veterinary diagnosis and final conclusions based on expert research.

Given that the procedures of forensic veterinary examination, being in the process of formation, require clear regulation and systematization of stages of forensic veterinary examination (in particular, animal carcasses), we have developed methods for describing and assessing the body and organs of the animal carcass, drawing up an opinion of the forensic veterinary expert based on the results of forensic veterinary autopsy, the procedure for removing objects of forensic veterinary examination from the carcass of an animal and their further laboratory examination, the rules of forensic veterinary examination of animal carcasses. In addition, we have prepared for publication a textbook *"Forensic Veterinary Thanatology: The doctrine of dying, death and cadaveric phenomena"*, which combines various expert cases and reflects the essence and structure of a particular stage of forensic veterinary examination.

Scientific and theoretical developments we test and implement in practice during the forensic veterinary examination of animal carcasses at the National Scientific Center «Hon. Prof. M. S. Bokarius Forensic Science Institute», the number of which is growing rapidly every year.

38 Щербаковський М. Г. Зазнач. твір.

39 Listos P., Gryzinska M., Kowalczyk M. Op. cit.

Стадії експертного дослідження та їх застосування у судово-ветеринарній експертизі трупів тварин

Іван Яценко

Обґрунтовано, що стадійність експертного дослідження під час судово-ветеринарної експертизи трупів тварин ґрунтується на загальних методичних положеннях судової експертології і містить принаймні чотири стадії: підготовчу (попереднє дослідження), аналітичну (роздільне дослідження), порівняльну та синтезуючу (оцінну), не лише відбиваючи процедуру пізнання експертом властивостей об'єктів судово-ветеринарної експертизи, а й даючи змогу простежити процес проведення експертизи й оцінити здобуті результати під час оцінювання висновку експерта.

Кожна стадія експертного дослідження трупів тварин обумовлена різними технічними прийомами й завданнями дослідження та забезпечує розв'язання проміжних завдань, які здебільшого мають діагностичний характер. Спільність стадій відображає загальні моменти, характерні для будь-якого експертного дослідження як одного з різновидів форм пізнання. Різниця полягає в частці й обсязі однойменних стадій у структурі діагностичних досліджень. Черговість застосування згаданих стадій сприяє логічно правильному аналізуванню виявлених патоморфологічних ознак і (на підставі всебічного їх оцінювання) формулюванню судово-ветеринарного діагнозу та складанню остаточного висновку експерта.

Розроблено порядок вилучення об'єктів із трупа тварини і подальшого їх лабораторного дослідження, правила судово-ветеринарної експертизи трупів тварин, методичні рекомендації з описування й оцінювання стану ділянок тіла й органів трупа тварини, укладання висновку судово-ветеринарного експерта.

Ключові слова: *судово-ветеринарна експертиза; трупи тварин; стадії експертного дослідження; процес і завдання діагностичного дослідження; висновок експерта; методики опису й оцінювання стану ділянок тіла та органів трупа тварини.*

Стадии экспертного исследования и их применение в судебно-ветеринарной экспертизе трупов животных

Иван Яценко

Обосновано, что стадийность экспертного исследования в ходе судебно-ветеринарной экспертизы трупов животных базируется на общих методических положениях судебной экспертологии и включает четыре стадии: подготовительную (предварительное исследование), аналитическую (раздельное исследование), сравнительную и синтезирующую (оценочную), не только отражая процедуру познания экспертом свойств объектов судебно-ветеринарной экспертизы, но и позволяя проследить процесс проведения экспертизы и оценить полученные результаты при оценивании заключения эксперта.

Каждая стадия экспертного исследования трупов животных обусловлена разными техническими приёмами и задачами диагностического исследования и обеспечивает решение промежуточных заданий, имеющих, в основном, диагностический характер. Общность стадий отражает общие моменты, присущие любому экспертному исследованию как одной из разновидностей форм познания. Разница заключается в доле и объёме одноимённых стадий в структуре диагностических исследований. Очерёдность применения упомянутых стадий способствует логически правильному анализированию обнаруженных патоморфологических признаков

и (на основе всестороннего их оценивания) формулированию судебно-ветеринарного диагноза и составлению окончательного заключения эксперта.

Разработаны порядок изъятия объектов из трупа животного и последующего их лабораторного исследования, правила судебно-ветеринарной экспертизы трупов животных, методические рекомендации по описанию и оцениванию состояния участков тела и органов трупа животного, по составлению заключения судебно-ветеринарного эксперта.

Ключевые слова: *судебно-ветеринарная экспертиза; трупы животных; стадии экспертного исследования; процесс и задачи диагностического исследования; заключение експерта; методики описания и оценивания состояния участков тела и органов трупа животного.*

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The author declare that he have no conflict of interest.

References

Beirne, P. (2006). For a nonspeciesist criminology: Animal abuse as an object of study. *Criminology.* Vol. 37. Is. 1. DOI: 10.1111/j.1745-9125.1999.tb00481.x.

Benetato, M. A., Reisman, R., McCobb, E. (2011). The veterinarian's role in animal cruelty cases. *Javma : Journal of the American Veterinary Medical Association*. Vol. 238. Is. 1. DOI: 10.2460/javma.238.1.31.

Brinkmann, B. (1999). Harmonisation of Medico-Legal Autopsy Rules. *International Journal of Legal Medicine.* Vol. 113 (1). DOI: 10.1007/s004140050271.

Brooks Brownlie, H. W., Munro, R. (2016). The Veterinary Forensic Necropsy: *A Review of Procedures and Protocols. Veterinary Pathology.* Vol. 53 (5). DOI: 10.1177/0300985816655851.

Bruchim, Y., Loeb, E., Saragusty, J., Aroch, I. (2009). Pathological Findings in Dogs with Fatal Heatstroke. *Journal of Comparative Pathology.* Vol. 140. Is. 2—3. DOI: 10.1016/j.jcpa.2008.07.011.

Byard R. W., Boardman W. (2011). The potential role of forensic pathologists in veterinary forensic medicine. *Forensic science medicine and pathology.* Vol. 7. Is. 3. DOI: 10.1007/s12024-011-9241-x.

Grela, M., Listos, P., Gryzinska, M., Chagowski, W., Buszewicz, G., Teresinski, G. (2018). Imaging techniques as a method of sectional examination in forensic veterinary medicine. *Medycyna weterynaryjna.* Vol. 74. Is. 12. DOI: 10.21521/mw.6005.

Gwaltney-Brant, S. M. (2016). Veterinary Forensic Toxicology. *Veterinary Pathology.* Vol. 53. Is. 5. DOI: 10.1177/0300985816641994.

Iatsenko, I., Derecha, L., Kazantsev, R. (2021). Noveishie nauchnye i prakticheskie dostizheniia i perspektivy razvitiia sudebno-veterinarnoi ehkspertizy trupov zhivotnykh v Ukraine [The latest scientific and applied achievements and prospects for development of forensic veterinary investigation of

animal carcasses in Ukraine]. *Legea şi Viaţa.* № 1. Vol. II [in Russian].

Kliuiev, O. M. (2019). Udoskonalennia ekspertnoho zabezpechennia pravosuddia: teoretychni, pravovi ta orhanizatsiini aspekty [Improvement of forensic support: theoretical, legal and organizational aspects]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky.* Vyp. 19. DOI: 10.32353/khrife.1.2019.08 [in Ukrainian].

Listos, P., Gryzinska, M., Kowalczyk, M. (2015). Analysis of cases of forensic veterinary opinions produced in a research and teaching unit. *Journal of Forensic and Legal Medicine.* Vol. 36. DOI: 10.1016/j.jflm.2015.08.002.

Mangematin, G. (1999). Post-mortem examination in food-producing animals. *Regulations and standards. Point veterinaire.* Vol. 30 (203).

McDonough, S. P., McEwen, B. J. (2016). Veterinary Forensic Pathology: The Search for Truth. *Veterinary Pathology.* Vol. 53. Is. 5. DOI: 10.1177/0300985816647450.

McEwen, B. J. (2016). Nondrowning Asphyxia in Veterinary Forensic Pathology: Suffocation, Strangulation, and Mechanical Asphyxia. *Veterinary Pathology.* Vol. 53. Is. 5. DOI: 10.1177/0300985816643370.

Melekh, L. V. (2015). Otsinka dokaziv yak zakliuchnyi etap protsesu dokazuvannia [Evaluation of evidence as the final stage of the evidentiary process]. *Visnyk Luhanskoho derzhavnoho universytetu vnutrishnikh sprav imeni E. O. Didorenka.* T. 1. № 69 [in Ukrainian].

Mills, G. (2013). Proving the crime: how veterinary forensics can help. *Veterinary record.* Vol. 172 (18). DOI: 10.1136/vr.f2694.

Munro, R., Ressel, L., Gröne, A., Hetzel, U., Jensen, H. E., Paciello, O., Kipar, A. (2020). European Forensic Veterinary Pathology Comes of Age. *Journal of Comparative Pathology.* Vol. 179. DOI: 10.1016/j.jcpa.2020.08.003.

Osnovy sudovoi ekspertyzy: navchalnyi posibnyk dlia fakhivtsiv, yaki maiut namir otrymaty abo pidtverdyty kvalifikatsiiu sudovoho eksperta [Fundamentals of forensic science: training manual for professionals who intend to obtain or confirm the qualification of a forensic expert] (2016) / avt.-uklad.: L. M. Holovchenko, A. I. Lozovyi, E. B. Simakova-Yefremian ta in. Kharkiv [in Ukrainian].

Osypenko, I. P., Prorochenko, V. V. (2020). Vysnovok eksperta v dosudovomu rozsliduvanni [Expert's conclusion in the pre-trial investigation]. *Yurydychnyi naukovyi elektronnyi zhurnal.* № 2. DOI: 10.32782/2524-0374/2020-2/104 [in Ukrainian].

Ottinger, T., Rasmusson, B., Segerstad, C. H. A., Merck, M., Goot, F. V. D., Olsen, L., Gavier-Widen, D. (2014). Forensic veterinary pathology, today's situation and perspectives. *Journal of Comparative Pathology*. Vol. 175. Is. 18. DOI: 10.1136/vr.102306.

Parry, N. M. A., Stoll, A. (2020). The rise of veterinary forensics. *Forensic Science International.* Vol. 306. Art. 110069. DOI: 10.1016/j.forsciint.2019.110069.

Piegari, G., Cardillo, L., Alfano, F., Vangone, L., Iovane, V., Fusco, G. (2020). Pathological, Bacteriological and Virological Findings in Sudden and Unexpected Deaths in Young Dogs. *Animals.* Vol. 10. Is. 7. DOI: 10.3390/ani10071134.

Ressel, L., Hetzel, U., Ricci, E. (2016). Blunt Force Trauma in Veterinary Forensic Pathology. *Veterinary Pathology.* Vol. 53. Is. 5. DOI: 10.1177/0300985816653988.

Ribas, L. M., Massad, M. Rr., Pinto, A. C., Heng, H. G., Tremori, T. M., Reis, S. T., Baroni, C. O., Massad, E., Rocha, N. S. (2020). Post-mortem CT vs necropsy in feline medicine. J*ournal of Feline Medicine and Surgery.* Vol. 22. Is. 12. DOI: 10.1177/1098612X20919310.

Rowden, P., Steinhardt, D., Sheehan, M. (2008). Road crashes involving animals in Australia. *Accident Analysis and Prevention*. Vol. 40. Is. 6. DOI: 10.1016/j.aap.2008.08.002.

Shcherbakovskyi, M. H. (2015). *Provedennia ta vykorystannia sudovykh ekspertyz u kryminalnomu provadzhenni* [Conducting and using forensic examinations in criminal proceedings] : monohrafiia. Kharkiv [in Ukrainian].

Simakova-Yefremian, E. B. (2017). Do pytannia vzaiemozalezhnosti yevropeiskykh intehratsiinykh protsesiv i tendentsii intehratsii spetsialnykh znan v Ukraini [To the question of interdependence of the European integration processes and integration tendencies of special knowledge in Ukraine]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 17 [in Ukrainian].

Simakova-Yefremian, E. B. (2017). *Teoretyko-pravovi ta metodolohichni zasady kompleksnykh sudovo-ekspertnykh doslidzhen* [Theoretical, legal and methodological principles of complex forensic research] : dys. … d-ra yuryd. nauk. Kharkiv [in Ukrainian].

Siqueira, A. de, Cassiano, F. C., Landi, M. F. D., Marlet, E. F., Maiorka, P. C. (2012). Non-accidental injuries found in necropsies of domestic cats: a review of 191 cases. *Journal of Feline Medicine and Surgery.* Vol. 14. Is. 10. DOI: 10.1177/1098612X12451374.

Touroo, R., Fitch, A. (2012). Identification, Collection, and Preservation of Veterinary Forensic Evidence: On Scene and During the Postmortem Examination. *Journal of Feline Medicine and Surgery.* Vol. 14. Is. 10. DOI: 10.1177/0300985816641175.

Yatsenko, I. V., Derecha, L. M. (2019). Mozhlyvosti sudovo-veterynarnoi ekspertyzy yak novoho vydu sudovykh ekspertyz [Possibilities of forensic veterinary as a new type of forensic science]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 19. DOI: 10.32353/khrife.1.2019.044 [in Ukrainian].

Yatsenko, I. V., Derecha, L. M., Parylovskyi, O. I. (2021). Novitni naukovi y praktychni zdobutky ta perspektyvy rozvytku sudovo-veterynarnoi ekspertyzy zhyvykh tvaryn v Ukraini [The latest scientific and practical achievements and prospects for the development of forensic veterinary examination of live animals in Ukraine]. *Aktualni pytannia ta perspektyvy rozvytku sudovoi ekspertyzy ta kryminalistyky* : mat-ly Mizhnar. nauk.-prakt. konf. (Odesa, 03.09.2021). Odesa [in Ukrainian].

Yatsenko, I. V., Parylovskyi, O. I. (2020). Novitni dosiahnennia v sudovo-veterynarnii ekspertyzi tvaryn, postrazhdalykh vid zhorstokoho povodzhennia [Recent advances in forensic veterinary examination of animals affected by violent attitude]. *Naukovyi visnyk Lvivskoho natsionalnoho universytetu veterynarnoi medytsyny ta biotekhnolohii im. S. Z. Gzhytskoho. Seriia: Veterynarni nauky.* T. 22. № 97. DOI: 10.32718/nvlvet9716 [in Ukrainian].

Yatsenko, I., Simakova-Yefremian, E., Derecha, L. (2021). Metody sudovoi ekspertyzy ta yikh zastosuvannia u sudovo-veterynarnykh doslidzhenniakh [Forensic expertise

methods and their application in forensic veterinary research]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 2 (24). DOI: 10.32353/khrife.2.2021.04 [in Ukrainian].

Yatsenko, I. (2022). Stages of expert research and their application in the forensic veterinary examination of animal carcasses. *Theory and Practice of Forensic Science and Criminalistics.* Issue 1 (26). P. 52—78. DOI: 10.32353/khrife.1.2022.04.

Research on short manuscripts made by the elderly and old age people

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The purpose of this research paper is to generalize and systematize forensic expert experience (as theoretical knowledge as research practice) and the scientific basis for research on of short manuscripts made by elderly and old age people of obtained experimental data; to give regularities of handwriting and to explain the nature of occurrence of diagnostic signs; develop recommendations for forensic handwriting analyses and determine the procedure structure (algorithm of forensic expert actions) to solve identification and diagnostic tasks; collect information about the identification value and the possibility of differentiation of the mentioned signs. Forensic expert practice requires qualitative specific criteria that would unequivocally confirm relative stability of signs in short manuscripts made by elderly and old age people. Thereby this issue is given special attention.

Thanks to the research carried out during 2019—2021 at NSC «Hon. Prof. M. S. Bokarius FSI» experimental research and generalization of expert practice developed a technique for handwriting research of short handwritten records made by elderly and old age people that allows solving identification and diagnostic tasks to establish the performer (performers) of such records and the

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conditions for their implementation; a detailed algorithm of actions of the expert in the process of solving this issue is given.

The technique is based on a two-level principle, the essence of which is that the expert conducts the research not just in stages, but performs it cyclically, that is, with a different degree of depth and approximation to the final solution at different levels.

Keywords: *handwriting; short handwritten records; elderly and old age people; diagnostics; writing and motor skills; age-related changes in the body; morbidity; coordination of movements.*

Research Problem Formulation

Recently, short handwritten notes made by elderly and old age people have become more and more common objects of forensic handwriting analysis The lack of uniform methodological approaches to the identification research on these handwriting implementations causes certain difficulties in the work of handwriting experts. This is due to peculiarity of separate and comparative researches including nature explanation of the occurrence of diagnostic signs in short manuscripts made by elderly and old age people and determine the frequency of their detection. The latter makes it possible to identify the most persistent traits that are rare or only in certain variants, as well as chains of sequentially dependent individual traits.

Specificity of the forensic research on short manuscripts made by elderly and old age people is that due to natural physiological aging of the body, signs of handwriting change. Over time, handwriting degradation also occurs due to little writing practice, especially when a person has stopped actively writing at the stage of handwriting automatism. Therefore, while examining short manuscripts made by elderly and old age people, forensic experts face significant difficulties in identifying handwriting signs and assessing their significance, finding out the causes of discrepancies and determining their significance.

Analysis of Essential Researches and Publications

Psychiatric, medical and forensic literature contains a lot of data on the degree and nature of motor function disorders in the elderly and seniors due to the disease state of the body, as well as on the possibilities and limits of stabilizing this process in some chronic and non-chronic diseases. This suggests a possible persistence of changes in handwriting signs (due to impaired motor functions) for some time, which can be used to perform identification studies.

Among the scientific works devoted to the study of handwritten texts performed by elderly and seniors, it is worth mentioning the works of such scientists as: A. H. Birshenker, A. Erlenmeier, M. M. Manaseina, B. V. Pavlov, O. U. Zitser, O. R. Luriia, Ye. K. Sepp, V. V. Tomilin, T. O. Chepulchenko, V. V. Lypovskyi, M. Ye. Bondar[1].

1 Биршенкер А. Г. Расстройство сочетательных движений при письме. *Военно-медицинский журнал*. Санкт-Петербург, 1871 ; Erlenmeyer A. Die Schrift: Grundzüge ihrer Physiologie

Article Purpose

The purpose of this research paper is to generalize and systematize forensic expert experience (as theoretical knowledge as research practice) and the scientific basis for research on of short manuscripts made by elderly and old age people of obtained experimental data; to give regularities of handwriting and to explain the nature of occurrence of diagnostic signs; develop recommendations for forensic handwriting analyses and determine the procedure structure (algorithm of forensic expert actions) to solve identification and diagnostic tasks; collect information about the identification value and the possibility of differentiation of the mentioned signs. Forensic expert practice requires qualitative specific criteria that would unequivocally confirm relative stability of signs in short manuscripts made by elderly and old age people. Thereby this issue is given special attention.

Main Content Presentation

Formed as a result of special training and practice of writing based on subjective adaptation to a variety of external and internal conditions, the writing and motor skill (or functional-motor skill) acquires its own features in the person who writes. In other words, the handwriting of any person, no matter at what age they write, is individual and different from the handwriting of the rest of the person. Thus, the performers of short handwritten records made by elderly and old age people can be identified.

Professionals of NSC «Hon. Prof. M. S. Bokarius FSI» during 2019-2021 [2] experimentally studied handwriting in short manuscripts made by elderly and old age people. Obtained data allowed to draw certain conclusions about the identification value and the possibility of differentiation of features characteristic of the handwriting of elderly and senile and handwriting performed by imitation.

und Pathologie. Stuttgart : Adolf Bonz & Co., 1879. 72 с. ; Манасеина М. М. О письме вообще, о зеркальном письме в частности и о роли обоих полушарий большого мозга. Санкт-Петербург, 1883 ; Павлов Б. В. Нарушения чтения и письма при проникающих черепно-мозговых травмах военного времени и динамика их восстановления. *Рефераты работ учреждений Отделения биологических наук Академии наук СССР за 1941—1943 гг.* Москва ; Ленинград, 1945. С. 376—377 ; Зицер Е. У. Наиболее устойчивые признаки почерка. *Проблемы криминалистики.* Москва, 1947. С. 31—37 ; Лурия А. Р. Очерки психофизиологии письма. Москва, 1950. 352 с. ; Сепп Е. К. О локализации функций в коре головного мозга. *Журнал невропатологии и психиатрии имени С. С. Корсакова.* 1955. Т. 55. Вып. 12. С. 881—889 ; Томилин В. В. Об естественном изменении признаков почерка на протяжении жизни человека : мат-лы 3-го Всесоюз. совещ. суд.-мед. эксперт. и 3-й Всесоюз. конф. науч. общ. судеб. мед. и криминалист. Рига, 1957 ; Чепульченко Т. А. Криминалистическое исследование рукописных текстов, выполненных лицами пожилого и старческого возраста. *Современное состояние почерковедческой экспертизы.* Москва, 1981. С. 112—114 ; Липовский В. В. Криминалистическое исследование подписей, выполненных от имени лиц пожилого и старческого возраста : метод. пособ. для экспертов. Москва, 1983. 64 с. ; Бондар М. Є. Встановлення характеру збиваючих факторів при дослідженні підписів, що виконані з порушенням координації рухів : метод. рек. Київ, 2001. 36 с.

2 Розробка методики почеркознавчого дослідження коротких рукописних записів, виконаних особами похилого й старечого віку : звіт НДР (заключ.) / МЮУ ; ННЦ ІСЕ ; кер. Д. І. Гайдамакіна ; викон.: О. М. Смоліна, О. С. Дробишева та ін. Харків, 2021. 164 с.

Experiment involved 35 elderly people (60-75 years old) and 35 old age people (75-90 years old), whose handwriting was characterized by high, medium and low levels of production, simple, simplified and complex structure. The research took place in three stages. The first stage was selection of free handwriting samples for the elderly and old age people. In the second stage, the same persons provided experimental handwriting samples in the form of short handwritten notes to the usual writing instruments, usual hand for writing, in usual conditions (sitting at a table, in natural light, if necessary, in glasses). In the third stage, 30 outsiders made short handwritten notes, following the handwriting of the elderly and old age people. Stability of handwriting in the conditions of natural physiological aging (in the lack or existence of certain diseases that impair motor functions) was studied by professionals on free and experimental samples of handwriting of the elderly and old age people.

In addition, the identification value of the features was studied, summarizing more than 50 expert proceedings [3]. The results of the experiment were processed, using knowledge about the basis of the structure of written signs, the frequency of repetition of a particular sign, variability and stability of handwriting of the elderly and elderly. The researchers aimed to develop (on the basis of the obtained experimental data and the analysis of expert practice) recommendations for conducting examinations on the study of short handwritten records made by such persons, and as a final result is a methodology for studying handwritten records made by these persons.

Generalization of expert practice and experimental array made possible to distinguish informative general and individual signs of handwriting that help to differentiate the handwriting of elderly and old age people.

Informative general and individual signs of handwriting

1. *Coordination of movements* is a sign of handwriting reflecting consistency (accuracy) of the performer movements, depending on the formation degree of writing and motor skills, as well as conditions of handwriting objects. Each muscle participates in the overall movement with a certain force and begins to act at a certain time. The sequence (coordination) of actions in which a particular muscle is involved, due to the work of the musculoskeletal system of the cerebral cortex, subcortical nodes and brain stem. Coordination requires accurate signals from the periphery about the position of body parts every second, the speed of movements that occur, and the strength of resistance to these movements. These signals come from sensitivity receptors. Coordination of movements of the 1st group testifies to accuracy of observance of parameters of small movements (elements of letters, separate strokes executed by bending and extensor movements). Coordination of movements of the 2nd group ensures the accuracy of the parameters of large movements: inclination, size, mutual vertical and horizontal placement of written signs and their elements. In the absence or lack of accuracy of signals from the receptors *ataxia* (impaired coordination) occurs. Handwriting of the elderly and old age is characterized by decreased coordination of movements. Atactic handwriting is characterized by the lack of straight long strokes, they seem to be broken in some places, the same evils are observed in curvilinear strokes (ovals, semi-ovals).

3 Archives of KhRIFE during 2015—2019.

Atactic handwriting is characterized by the wrong shape of the letters, their erratic tilt, size and acceleration, too long strokes, which makes such handwriting indistinct and difficult to read. Decreased coordination of movements of the 1st group is manifested in tortuous shape of the strokes, repeated awkwardness, angularity and fractures of strokes, inaccurate beginnings and endings of movements. Tortuosity of the shape of movements can be large and small and is characterized by inaccuracy in execution of rectilinear, arc, oval, semi-oval and connecting elements. It characterizes the system of movements in handwriting and acquires relative constancy. (Fig. 1).

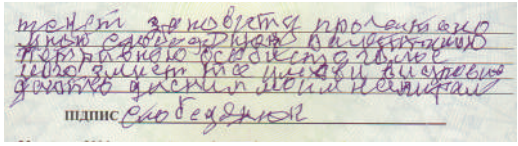

Fig. 1

Reduced coordination of movements of the 2nd group is manifested in the disproportionate parameters of large movements: uneven size, acceleration, placement and unstable inclination of written signs. In the handwriting of the elderly and senile there is often a decrease in coordination of movements of the 2nd group. Tortuosity of the strokes is due to trembling of the fingers, i.e. involuntary movements that disrupt the smoothness of the strokes by rhythmic oscillations due to the alternating contraction of a certain muscle circle. Tremor begins to manifest early in the handwriting. Due to small tremors of the hand during writing, the handwriting becomes shaky, i.e. straight strokes, especially deflection and drive, become tortuous. The handwriting in this case mostly remains clear, legible, but in some cases (due to severe shaking of the hand) it can become difficult to read. Trembling of the hand and (as a consequence) tortuosity of the strokes during writing can sometimes also cause physiological reasons strong excitement and so on. Repeated angularity (as an integral part of the coordination of movements) is most evident in the fact that when performing elements of letters and their connections, loop and arc forms of movements give way to rectilinear-angular with a change in direction. Angularity is most often detected while performing lowercase letters (Fig. 2).

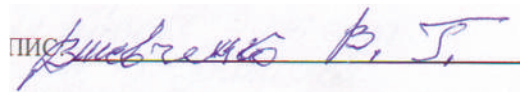

Fig. 2

2. *Writing pace* is a sign of handwriting reflecting the manuscript speed. Handwriting of the elderly and senile is characterized by the usual pace of writing, namely: a) slow: blunt beginning and end of strokes, often simple letter structure, low coherence or lack thereof (interval execution or execution of written signs and their elements movements that adjacent); b) medium: correct execution of arc elements, average connectivity, differentiated pressure; c) fast: significant connectivity, differentiated pressure, thinning of strokes in the initial and final parts of the elements, various simplifications. Handwriting of this category of people is also characterized by an unusually fast pace (manifested in the simplification of written signs, loss of their elements, omission of words, omission of words in words, shortening words, increasing coherence and acceleration) is often combined with decreased coordination. For imitating handwriting of old age people is characterized by an unusual slow pace, which is manifested in the fragmentary execution of written

signs and their elements, existence of blunt beginnings and endings of strokes, their thickening, unwarranted stops of the writing instrument, undifferentiated pressing; often combined with a decrease in coordination of movements of the 1st group under influence of confounding factors.

3. *Handwriting structure* reflects the degree of complexity of movements, which is associated with the tendency to form a very fast, rather fast and clear writing. The handwriting of the elderly and the elderly is characterized by a simple or simplified structure of movements while execution of letters. In general, it corresponds to worksheets. handwriting of elderly and old age people is unequal, indelible. Sometimes capital letters are executed as small letters.

4. *Pressing* displays the total intensity and distribution of effort on the writing instrument. Pressure elderly and old age people is usually standard differentiated and uneven: from weak in the initial part of the word to strong in the final part.

5. *Inclination* (position of the longitudinal axes of written signs and their elements) is divided into: right, left, no inclination (the position of the longitudinal axes is close to the vertical). Elderly and old age persons are characterized by an unstable inclination that is determined by the angle between the main strokes and writing line or the blank line, if the performer adheres to this blank line during writing. Unstable slope is detected in uneven deviation of letters and strokes from the conditional vertical straight line. With a left-hand slope, the main strokes are tilted to the left, the angle of inclination fluctuates (most often from 95° to 105°). The inclination angle of the main strokes in the right-hand handwriting is 70—80°, in the vertical one —85-95 °.

6. *Acceleration* is the length ratio of movements horizontally (the distance between the main elements of written signs and between them) and the length of movements vertically; elderly and old age people acceleration is usually unstable and characterized by a different ratio between the height and width of letters and strokes. Very often it increases at the end of the word.

7. *Connectivity of movements* is the degree of continuity of writing during the execution of letters within one word; it is determined by the number of letters executed in a solid manner, and is divided into: solid, large, medium, small, lack of connectivity (all letters are executed separately). In the handwriting of elderly and old age people, connectivity of letters and strokes is usually small or absent — there are fragmentary movements while execution of letters and their elements. Such execution of letter elements involves writing in separate movements (Fig. 3).

Fig. 3

8. *Content organization of writing* — availability of outline, new letters, omission of letters, repetition (perseveration). The outline, that is, the imposition of one stroke on another on an already executed letter or its element in order to repeat their general configuration is found in manuscripts of elderly and old age people during execution of individual elements of the letters or the letter as a whole. Execution of new letters and corrections involve making certain corrections in the record by crossing out previously executed signs and executing new ones (Fig. 4).

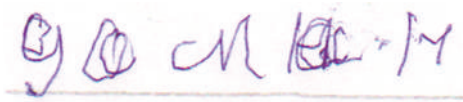

Fig. 4

9. Signs reflecting the *structural characteristics of movements*:

- predominant form of movements is determined by the degree and nature of participation of different groups of muscles involved in writing. In the elderly and the elderly, curvature or a mixed form of movements is observed in the handwriting in general. Angularity is characterized by clumsy movements devoid of smoothness, by direction of movements changes dramatically while execution of elements of letters. Handwriting becomes fuzzy;
- preferred direction of movements is raised with respect to the blank line; a rectilinear horizontal direction is encountered. It is possible to observe the bends of the lines, where the lines are most often concave with respect to the blank line (less often — convex). The bending of the lines is almost always uneven and is clearly detected at the end of the lines.

Furthermore, elderly and old age people have fragments in the text that differ among themselves in general terms that implies instability in connection, size, acceleration and other signs during part of the study record. Fragments of a word record may differ from each other or in several of the above features. For example, the presence of a small overclock at the beginning of the recording and an increased overclock at the end of a sentence or phrase. This signs does not depend on the recording rate (Fig. 5, 6).

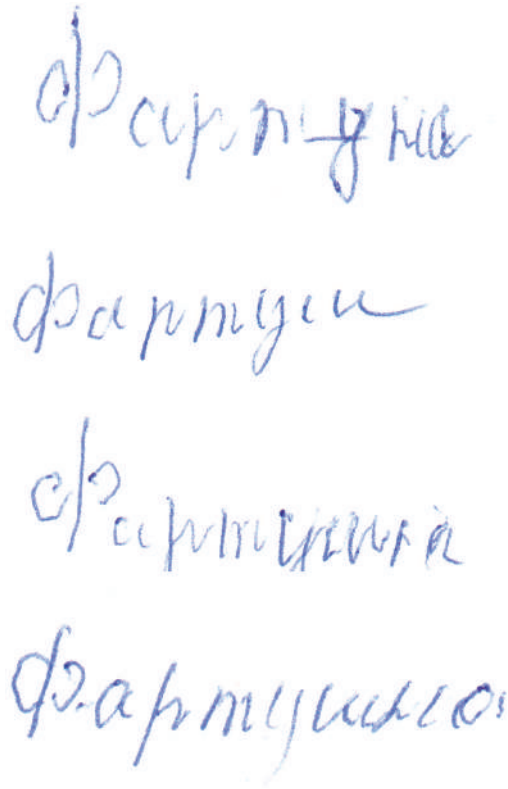

Fig. 5

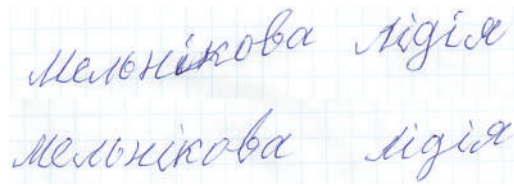

Fig. 6

These general signs can be found in the handwriting in general, in the group of letters and in individual letters and strokes. At the stage of a separate research, forensic expert studies handwriting of short handwritten records in order to identify informative signs in it that indicate the performance of short handwritten records by an elderly person.

Data generalization obtained while experiment and the analysis of expert practice indicate the following.

Firstly, in the elderly and senile signs of impaired coordination in the form of broken strokes are found at the beginning of the word more often than at the end.

This is especially noticeable in words performed with continuous movements. This is due to the fact that the elderly and old age people experience some difficulties at the beginning of the recording, but then these difficulties are reduced due to the dynamic stereotype.

Secondly, there is a lack of stability and stability in the placement of stroke breaks (as a violation of coordination). In other words,, fractures are not always and not necessarily in the same place. It depends on the condition of the person who writes and the conditions of the recordings.

Thirdly, there is a dependence of the appearance of fractures in the strokes on future change of direction of movement, due to the difficulties that arise in the person writing, due to the change of direction due to loss of coordination.

Fourthly, there is a dependence of the appearance of signs of senile handwriting on the presence of a connection with the following strokes. In the absence of such connections in the final and initial strokes of the letters, these signs appear more often.

Fifth, the most common signs of incoordination are observed in those parts of the letter elements that are performed by extensor movements. The main sign of impaired coordination of movements in the handwriting of the elderly and senile, associated with age-related changes in the body; availability of fractures in handwriting elements (Fig. 7).

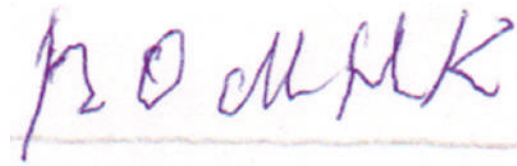

Fig. 7

Signs of decreased coordination of movements were found primarily in places of change in the direction of movement, as well as in areas of oval elements of letters or elements made by extensor or drive movements. With further intensification of beating factors caused by aging or the appearance of diseases that affect motor functions, signs of incoordination may be found in areas of letter elements or elements in general, performed by bending or deflection movements. However, in all cases, even with a significant destruction of the dynamic stereotype of handwriting, these features are mainly localized in the elements performed by extensor and drive movements. Therefore while solving identification and diagnostic tasks, forensic expert should carefully analyze studied handwriting in order to determine nature and predominant localization of signs of impaired coordination. Then it is necessary to analyze nature and predominant localization of these signs and determine whether it is characteristic of the elderly and old age people with motor impairments. In addition, it is necessary to distinguish between signs of impaired coordination of movements that occurred in the case of handwriting imitation of elderly and old age people and signs of impaired coordination, characteristic of the handwriting of these persons. In this case, in addition to data on nature and predominant localization of signs of impaired coordination, you must also take into account: 1) stability

lack in placement of such signs in the real handwriting. They can be in a particular element (area), but not necessarily in one place. Usually such signs are observed in the same place, especially while their performing with imitation; 2) lack of these short handwritten records of unreasonable stops of writing instrument in places of change of direction; 3) existence of more significant detection of signs of impaired coordination in initial part of the records. In this case, often, especially if they are performed in a state of significant physical weakness, in this part of the records there are a number of unreasonable strokes of different sizes and directions, unrelated. In addition, there is often increased detection of signs of impaired coordination in the final part of the recording that is associated with fatigue. In forged handwriting, due to availability of handwriting samples made by the person in a seriously ill condition, impaired coordination signs of movements are placed evenly throughout the record. In addition, they do not have unreasonable strokes in the initial part of recording that indicates a difficult *start reflex* of the inclusion of a dynamic stereotype of handwriting of elderly and old age people; 4) detection dependence of signs of impaired coordination of movements on the presence or absence of coherence of movements with the following strokes. In absence of such connections in the final and initial strokes of the letters, these symptoms occur more often. Elderly and old age people for some diseases (cerebrovascular disorders, tremor paralysis, myocardial infarction) can be observed diagnostic signs: agraphia; complete or partial loss of ability to write (*agraphia* can be expressed in different ways from inability to write only some letters and words to the complete loss of ability to perform words completely with ability preservation to perform only individual letters and strokes, in some cases the preservation of the ability to perform letters lost the ability to connect them or preserved ability to spell correctly or replaced by a meaningless combination of letters or individual strokes), *paragraphia* of individual letters, syllables or whole words (in this case, elderly and old age people change places not only letters and syllables in one word but in different words (usually neighboring): for example, to write one word after another "e.g. written and "read "they can write "read" and "prescribed").

The sophistication of writing is manifested in the use of excessively refined forms of writing while writing. In ataxia, an elderly and old age person cannot accurately draw a perfectly straight line that violates the relationship between the individual strokes in the letter and between the letters in the word. Ataxic handwriting is characterized by the absence of straight long strokes, they seem to be broken in several places, the same fractures are observed in curvilinear strokes (ovals, hemispheres). The lines directed downwards are especially vigorous at ataxias. They reflect the degree of effort a person makes to avoid the wrong direction of the line and increase the pressure on the writing device to make up for the lack of sensation of movement. In general, ataxic handwriting is characterized by irregular letter shape, inconsistent tilt, size and acceleration, too long strokes that makes handwriting indistinct and difficult to read. In some cases, ataxia significantly distorts the symptoms that cannot only complicate the identification of the person, but also make it completely impossible. Tortuosity of the strokes while writing also occurs as a result of tremor, i.e. involuntary movements that disrupt the fluency of writing. While the left hemisphere of the brain is affected, various forms of aphasia

occur, i.e. ability to speak and write is impaired (at the same time there is no damage to the musculoskeletal system involved in writing).

There are three main forms of *aphasia*: sensory, amnestic and motor. *Sensory aphasia* retains only the ability to write under dictation and write without understanding what is being dictated or written down. In this case, the patient writes curls that remotely resemble letters or have no resemblance to them at all. In *amnestic* form of *aphasia*, the patient forgets the names of objects while writing. However, if the patient remembers a word, he will write it correctly. Agraphia and paragraphia can occur. Characteristic of handwriting is the frequent deletion of written words and letters due to the uncertainty of the person writing, in the correctness of their spelling. Lesions of the frontal lobe of the brain are usually accompanied by motor *aphasia*, *agraphia*, *apraxia* (loss of ability to use letters correctly), *deautomatization* of movements while writing, especially precise hand movements. There are repetitions of the same letters several times in a row (perseveration), omissions of letters, the transformation of complex words into one or two elements. Occasionally there is a lack of words. Occipital and occipital parietal areas of the brain are affected by optical agraphia, amnestic aphasia, and apraxia. Optical agraphia is characterized by distortion of the drawing of written signs with the tendency of the mirror image due to the violation of the correct perception of space, their size and shape. Characteristic in such cases is the uneven size of the letters, awkwardness, unstable direction of the line due to insufficient spatial orientation of movements. Such writing is characterized by deautomatization of movements, a mirror image of letters or their individual elements and gives the impression of writing performed by an unusual (left) hand. In some cases, there is a replacement of one letter with another that was in the previous word. There is no correspondence and clarity of movements, execution of variable movements directly opposite in the direction is disturbed which is expressed in the fact that alternation of such movements is slowed down, and the volume of the movements themselves is increased.

Trembling paralysis (Parkinson's disease) is a disease of the elderly and senile. It is characterized by tremor and general stiffness. It usually begins at the age of 50-60. Trembling is most pronounced in the hands. The handwriting of patients is significantly disturbed. As the letters are written, their size decreases (micrography), the strokes appear tortuous, and the act of writing slows down considerably. Micrography is a characteristic feature of tremor paralysis. At a strong tremor patients keep a habitual hand unusual, try to find a convenient pose. In such handwriting there is a tortuosity of strokes and incoordination (ataxia). The writing of elderly and old age people with limited visual control has some signs, because their field of vision is narrowed. In such cases, the presence of a blind spot is of great importance. A person with limited visual control is unable to observe a line in writing in a large area and sees only a certain part of it at any given moment. Therefore, person writing cannot place the lines correctly, i.e. perpendicular to the side edges of the paper and parallel to each other: they are crooked and oblique. The handwriting of such people is usually coherent, because in the process of writing they are afraid of losing the direction of the line and try to tear the writing instrument off the paper as rarely as possible. Gaps between words are often uneven, as such individuals do not calculate their movements along the line.

Due to the lack of binocular vision in such people, it is difficult for them to calculate the distance from the eye to the object and, making corrections and additions, they make extra strokes, make strong pressure. Elderly and old age people who have lost their sight for a long time place lines and words better than people who have recently lost their sight. Obtained data while analyzing expert practice and experimental research on the handwriting of the elderly and old age people indicate that in substantiating conclusions, forensic experts often note the convergence of the same common signs: pace, size, slope, acceleration and connection elements, direction record. At the same time, there are peculiarities in the detection nature of common signs indicating the procedure of breaking the dynamic stereotype in old age, due to influence of changes in the body. In most cases, experts cite general evidence in support of their conclusions, which indicates a decrease in the degree of coordination of movements (slow pace, low coherence degree, etc.). Given the gap in time between the execution of studied manuscripts and samples, forensic experts often note discrepancy of some common signs. These include: omission of letters, tilt of the elements (detection of instability), increase in size, the degree of coordination of movements (decrease), pace of execution (deacceleration). Forensic experts assess these signs as uncharacteristic, detection is explained by unusual conditions of recording, unusual (painful) condition of the person writing, or age-related changes in the body. Categorical positive conclusion of the forensic handwriting expert is caused not by quantity and not quality of signs and set of such signs. Criteria of quantity and quality are of great importance for determining existence or lack of a set of characteristics.

The study of expert practice and experimental array shows difficulty of solving handwriting problems to identify the executor of the studied short manuscripts made by the elderly and old age people. Over the last 10 years, forensic experts have provided both categorical (positive or negative) conclusions about identity and plausible conclusions. Part of the research was completed by providing an opinion in the form of "not possible". For some reason, it was also reported that it was impossible to draw conclusions. Due to incompleteness of conclusions of previous examinations, re-examinations were often appointed. Most often, forensic experts found primarily diagnostic signs, in addition, the degree and nature of detection of these signs testified to implementation of studied manuscripts under influence of beating factors or altered movements, simulating old age people handwriting. The form of conclusions (their categoricalness) was influenced by such factors as complexity of studied objects, availability of diagnostic signs, performance of movements of simple structure and the limited amount of graphic material. Significant were the quantity and quality of comparative material provided for research, difficulty of obtaining it by the person who appointed handwriting examination, and this made it difficult to assess the handwriting expert identified diagnostic, convergent and divergent general and individual features, prevented tracking variability and stability of handwriting.

The result of performed work is a method of handwriting research on short handwritten records made by elderly and old age people. Methods are structured according to a two-level principle which essence is that research is carried out not only in stages, but performed cyclically, that is, with varying degrees of depth and

approximation to the final solution at different levels. Each level, each stage, each research stage ends with the formation of intermediate conclusions which evaluation takes place taking into account all previously obtained research results. Intermediate solutions form a logical sequence that leads to final conclusion? namely: forensic task solution. Gaps in this sequence, internal contradictions of intermediate conclusions, if they occur, should be the subject of special forensic analysis: if the expert does not solve issues in the intermediate stages, he will not be able to reach a final conclusion. The *first level* contains preliminary research, that culminates in nomination of general and individual expert versions and planning further research. The *second level* is a detailed complete research of handwriting objects with the final issue solution. In the structure of solving a diagnostic issue, three stages are distinguished: preparatory, identification and diagnostic one, which are also combined with two levels[4]. The *first level* (preliminary research) involves an initial, approximate approach to the solution of the main task. Within its framework, forensic expert works at the following stages: familiarization with all the materials provided, review (preliminary analysis) of the object under research, review of comparative material, preliminary comparative research, evaluation of the results of preliminary comparison and nomination of expert versions, planning of future expert actions. With the help of this level, forensic expert forms an idea of the main task elements, the degree of its complexity, possibility and direction of solution. Professional solves the identification and diagnostic subtask. The first level allows forensic expert to see the main thing in a limited time, get an idea of the expert situation, to bring the final result of the task closer, plan a methodically correct approach to its solution or to substantiate the opinion about the impossibility of such a solution. At this level, the expert decides on the transition to the second level of research or makes a request to the person (body) who has appointed an examination to provide the comparative material or additional information necessary for research. To the second level of handwriting research, the expert approaches with varying degrees of probability of solving an integration problem, with sufficient information about the executor of the studied handwritten records, with a sufficient amount of comparative material. The second level is a detailed comparative research. Preliminary integration results obtained by forensic expert at the first level are deepened, comprehensively evaluated that helps to establish objective information necessary to formulate a reasonable and reliable conclusion.

The *second level* consists of two stages: 1) identification and 2) diagnostic one. This level is the main one in the diagnostic process. At the second level, forensic expert reworks all the above subtasks. In addition, the first diagnostic subtask (if there are pronounced diagnostic signs in the study document) can be solved already at the first level at the stage of preliminary examination of the document. In this case, there is no need for a solution at the second level. However, if the preliminary analysis of the handwriting object does not give positive results in terms of identifying diagnostic signs, forensic expert transfers the decision of the first subtask to the second level, having previously noted at the first level the equilibrium of the versions of both the presence and absence of unusual

4 Куприянова А. А. Методические рекомендации решения судебно-почерковедческих диагностических задач. Минск, 1982. 61 с.

writing. At the identification stage, the professional decides identification subtask necessary for the final solution of the second diagnostic subtask. At this stage, identification and diagnostic signs, unlike preparatory are studied more carefully. A detailed and comprehensive study of the properties of writing, comparison and evaluation of these characteristics, allow to identify all available diagnostic signs, including slightly pronounced ones, to form complete reliable complexes of diagnostic signs necessary to solve the following subtasks. The content of identification stage consists of the following stages: analysis of all signs of writing (identification and diagnostic) in the object under research and comparative material, comparative study of these signs, evaluation of comparison results, formation of conclusions about identity of the performer and the commonality of the nature of the unusualness of writing. The diagnostic stage of the second level is final. Within its limits, the issue of species, a group of whipping factors, a specific whipping cause is solved. At this stage, the expert analyzes diagnostic signs, operates diagnostic complexes, conducts a comparative study of the latter with well-known diagnostic complexes, namely: standards. This stage of diagnostic research involves establishing the availability or lack of detection of any churning factors during the execution of examined handwritten records by visual observation and contains the following stages: establishing the availability or lack of informative diagnostic signs in handwritten records under research; establishing the availability or lack of informative diagnostic signs in handwriting samples of the identifiable person; comparison of informative diagnostic signs, if they are detected; evaluation of comparison results; formulation of conclusions about availability or lack of any whipping factors. Research on writing pace at this stage are carried out to differentiate the free (natural) pace and pace containing deceleration elements. The slowdown depends on a decrease in coordination of movements. It should be noted that the nature of the detection of signs of decreased coordination of movements, as in the case of handwriting with imitation of true handwriting of elderly and old age people is almost the same - indistinguishable small and large waviness during the execution of arc and straight strokes performed by both bending and indigestion movements. Sometimes, there is also an angle of movement in places of change in the direction of movements. A thorough research on these signs will allow forensic expert to clarify or revise the separate version put forward at the first stage of the previous study. The next stage is the study of informative diagnostic signs in handwriting samples of a certain person involves the establishment of not only the presence or absence of informative diagnostic signs, but also the degree and limits of their detection and (if possible) the diagnostic cause. This approach will further help to exclude superficial comparison and possibility of an error in assessing comparison results. The purpose of assessing comparison results is to state availability or lack of whipping factors during implementation of objects of comparative research and (if possible) to diagnose them (natural or artificial). At the same time, the final decision should be made by forensic expert only after conducting a detailed identification research.

Conclusions

The method of research on handwritten records made by elderly and old age

people possible to solve identification and diagnostic tasks to establish the performer (performers) of such records and conditions of performance. Above, the theoretical prerequisites for the handwriting research on short handwritten records performed by elderly and old age people are considered; some results of the generalization of a significant amount of both experimental array and expert practice on the possibilities of studying such handwriting objects are set out; handwriting signs characteristic of elderly and old age people are grouped; the algorithm of sequential actions of while expert during the solution of this issue is disclosed in detail.

It is known that forensic examination of short handwritten records made by elderly and old age people is one of the most difficult types of research in forensic handwriting. Features of the handwriting research on short handwritten records performed by elderly and old age people considered; forensic expert should take into account both in the process of while diagnostic procedure and during identification comparative research. The use of the above information in forensic practice optimizes and streamlines the expert activities will enable to perform forensic research, observing principles of completeness and comprehensiveness in accordance with the current legislation requirements.

Thus, research on handwriting features during the performance of short handwritten notes by elderly and old age people is relevant and requires further careful study.

Особливості дослідження коротких рукописних записів, виконаних особами похилого та старечого віку

Діана Гайдамакіна, Раса Тамошюнайте

Мета цієї наукової праці — на підставі здобутих експериментальних даних узагальнити й систематизувати експертний досвід (як теоретичні знання, так і дослідницьку практику) і наукове підґрунтя із дослідження коротких рукописних записів, виконаних особами похилого та старечого віку; навести закономірності почерку й пояснити природу виникнення діагностичних ознак; розробити рекомендації для проведення почеркознавчих експертиз і визначити структуру процесу (алгоритм дій експерта) для розв'язання ідентифікаційних і діагностичних завдань; дібрати відомості про ідентифікаційне значення й можливості диференціювання згаданих ознак. Експертна практика потребує якісних конкретних критеріїв, які б однозначно підтверджували відносну стійкість ознак у коротких рукописних записах, виконаних особами похилого та старечого віку. Саме тому цьому питанню приділено особливу увагу.

Завдяки проведеним упродовж 2019—2021 рр. у ННЦ «ІСЕ ім. Засл. проф. М. С. Бокаріуса» експериментальним дослідженням і узагальненню експертної практики розроблено методику почеркознавчого дослідження коротких рукописних записів, виконаних особами похилого та старечого віку, що дає змогу вирішувати ідентифікаційні й діагностичні завдання зі встановлення виконавця (виконавців) таких записів і умов їх виконання; наведено докладний алгоритм дій експерта в процесі розв'язання зазначеного питання.

Методика ґрунтується на дворівневому принципі, сутність якого полягає в тому, що фахівець проводить дослідження не просто поетапно, а виконує його циклічно, тобто з різним ступенем глибини й наближення до остаточного вирішення на різних рівнях.

Ключові слова: *почерк; короткі рукописні записи; особи похилого та старечого віку; діагностика; письмово-рухова навичка; вікові зміни організму; хворобливий стан; координація рухів.*

Особенности исследования кратких рукописных записей, выполненных лицами пожилого и старческого возраста

Диана Гайдамакина, Раса Тамошюнайте

Цель этой научной работы — на основании полученных экспериментальных данных обобщить и систематизировать экспертный опыт (как теоретические знания, так и исследовательскую практику) и научные основы по исследованию кратких рукописных записей, выполненных лицами пожилого и старческого возраста; привести закономерности почерка и пояснить природу возникновения диагностических признаков; разработать рекомендации для проведения почерковедческих экспертиз и определить структуру процесса (алгоритм действий эксперта) для решения идентификационных и диагностических заданий; подобрать информацию об идентификационном значении и возможностях дифференциации упомянутых признаков. Экспертная практика нуждается в качественных конкретных критериях, которые бы однозначно подтверждали относительную устойчивость признаков в коротких рукописных записях, выполненных лицами пожилого и старческого возраста. Именно поэтому данному вопросу уделено особое внимание.

Благодаря проведённым в течение 2019—2021 гг. в ННЦ «ИСЭ им. Засл. проф. Н. С. Бокариуса» экспериментальным исследованиям и обобщению экспертной практики разработана методика почерковедческого исследования кратких рукописных записей, выполненных лицами пожилого и старческого возраста, позволяющая решать идентификационные и диагностические задания по установлению исполнителя (исполнителей) таких записей и условий их выполнения; приведён подробный алгоритм действий эксперта в процессе решения указанного вопроса.

Методика построена на двухуровневом принципе, суть которого заключается в том, что специалист проводит исследование не просто поэтапно, а выполняет его циклически, то есть с различной степенью глубины и приближения к окончательному решению на разных уровнях.

Ключевые слова: *почерк; краткие рукописные записи; лица пожилого и старческого возраста; диагностика; письменно-двигательный навык; возрастные изменения организма; болезненное состояние; координация движений.*

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Declaration of Competing Interest
The authors declare that they have no conflict of interest.

References

Birshenker, A. G. (1871). Rasstroistvo sochetatelnykh dvizhenii pri pisme [Associative movement disorder while writing]. *Voenno-meditsinskii zhurnal.* Sankt-Peterburg [in Russian].

Bondar, M. Ye. (2001). *Vstanovlennia kharakteru zbyvaiuchykh faktoriv pry doslidzhenni pidpysiv, shcho vykonani z porushenniam koordynatsii rukhiv* [Establishing nature of confounding factors while research on of signatures

made in violation of coordination of movements] : metod. rek. Kyiv [in Ukrainian].

Chepulchenko, T. A. (1981). Kriminalisticheskoe issledovanie rukopisnykh tekstov, vypolnennykh litsami pozhilogo i starcheskogo vozrasta [Forensic research on handwritten texts made by persons of elderly and old age]. *Sovremennoe sostoianie pocherkovedcheskoi ehkspertizy.* Moskva [in Russian].

Erlenmeyer, A. (1879). *Die Schrift: Grundzüge ihrer Physiologie und Pathologie.* Stuttgart : Adolf Bonz & Co.

Kupriianova, A. A. (1982). *Metodicheskie rekomendatsii resheniia sudebno-pocherkovedcheskikh diagnosticheskikh zadach* [Methodological recommendations for solving forensic handwriting diagnostic issues]. Minsk [in Russian].

Lipovskii, V. V. (1983). *Kriminalisticheskoe issledovanie podpisei, vypolnennykh ot imeni lits pozhilogo i starcheskogo vozrasta* [Forensic research on signatures made on behalf of elderly and old persons] : metod. posob. dlia ehkspertov. Moskva [in Russian].

Luriia, A. R. (1950). *Ocherki psikhofiziologii pisma* [Essays on writing psychophysiology]. Moskva [in Russian].

Manaseina, M. M. (1883). *O pisme voobshche, o zerkalnom pisme v chastnosti i o roli oboikh polusharii bolshogo mozga* [About writing in general, about mirror writing in particular, and about the role of both cerebral hemispheres]. Sankt-Peterburg [in Russian].

Pavlov, B. V. (1945). Narusheniia chteniia i pisma pri pronikaiushchikh cherepno-mozgovykh travmakh voennogo vremeni i dinamika ikh vosstanovleniia [Reading and writing disorders in wartime penetrating craniocerebral injuries and the dynamics of their recovery]. *Referaty rabot uchrezhdenii Otdeleniia biologicheskikh nauk Akademii nauk SSSR za 1941—1943 gg.* Moskva ; Leningrad [in Russian].

Rozrobka metodyky pocherkoznavchoho doslidzhennia korotkykh rukopysnykh zapysiv, vykonanykh osobamy pokhyloho y starechoho viku [Development of a methodology for handwriting research of short handwritten records made by elderly and seniors] (2021) : zvit NDR (zakliuch.) / MIuU ; NNTs ISE ; ker. D. I. Haidamakina ; vykon.: O. M. Smolina, O. S. Drobysheva ta in. Kharkiv [in Ukrainian].

Sepp, E. K. (1955). O lokalizatsii funktsii v kore golovnogo mozga [On localization of functions in the cerebral cortex]. *Zhurnal nevropatologii i psikhiatrii imeni S. S. Korsakova*. T. 55. Vyp. 12 [in Russian].

Tomilin, V. V. (1957). *Ob estestvennom izmenenii priznakov pocherka na protiazhenii zhizni cheloveka* [On natural change in the signs of handwriting throughout a person's life] : mat-ly 3-go Vsesoiuz. soveshch. sud.-med. ehkspert. i 3-i Vsesoiuz. konf. nauch. obshch. sudeb. med. i kriminalist. Riga [in Russian].

Zitser, E. U. (1947). Naibolee ustoichivye priznaki pocherka [The most stable signs of handwriting]. *Problemy kriminalistiki*. Moskva [in Russian].

Gaydamakina, D., Tamoshiunaite, R. (2022). Research on short manuscripts made by the elderly and old age people. *Theory and Practice of Forensic Science and Criminalistics.* Issue 1 (26). P. 79—94. DOI: 10.32353/khrife.1.2022.05.

Features of forensic research on wheeled vehicles with LPG equipment

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The article considers the issue of LPG equipment installed and operated on modern vehicles, as well as its varieties, peculiarities of structure and configuration.

This article purpose is to get acquainted with the types of LPG equipment of modern cars and determine research peculiarities while forensic expert inspection of such vehicles.

The order of forensic expert actions while technical inspection of investigated wheeled vehicle is given, authors insist on the need to take into account the availability of LPG equipment while determining the market value of vehicle determining the cost of repair and material damage caused to the vehicle owner.

The advantages and disadvantages faced by car owners with installed LPG equipment are considered. Considerable attention was paid to the classification of gas cylinder equipment, discrepancies were noted while installation of gas LPG equipment on carburetor and injection engines.

Keywords: *forensic expert, LPG equipment, components of LPG equipment, air-gas mixture, environmental requirements, forensic expert inspection of wheeled vehicle.*

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Research Problem Formulation

While forensic inspection review of modern vehicles, forensic expert is faced with latest developments in automotive industry (in particular, LPG equipment installed on vehicles). Currently, there is a lot of LPG equipment (that differ in their design by generation, brands and models) installed on wheeled vehicles, so forensic expert needs to determine the type, variety, configuration, fastening points and determination of lifetime of the devices requiring additional forensic research.

Analysis of Essential Researches and Publications

Analysis of available LPG equipment installed on wheeled vehicles is periodically carried out[1]. The need to take into account the cost of installing LPG equipment on the car or its individual components, as well as the peculiarities of the structure and repair actions belong to the tasks of an forensic automobile expert.

Article Purpose

This article purpose is to get acquainted with the types of LPG equipment of modern cars and determine research peculiarities while forensic expert inspection of such vehicles.

Main Content Presentation

In modern conditions, a significant increase in the oil cost and fuel prices in the world and Ukraine, more and more car owners are transferring the engines of their vehicles to natural gas.

The first and greatest advantage of transferring road transport to the use of gas is to reduce fuel costs. In addition, there are other advantages of using this type of fuel in car [2]:

- high octane rating of gas practically eliminates detonation extending engine life cycle (savings on replacing motor oil and sparking plugs);
- motor oil life cycle increases by 15-20 %;
- engine inter-repair work increases;
- car can consume both types of fuel (gasoline or gas), for the which driver needs only to switch the toggle (switch);
- distance that can be traveled at one gas station increases;
- in the gas there are no catalysts for the destruction of metals and harmful impurities (lead and sulfur), it does not form soot on pistons, valves and sparking plugs (it extends life cycle);
- gas-air mixture is homogeneous while its combustion, the load on the piston group and the crankshaft are significantly reduced, so the engine works softer;
- due to combustion peculiarities of the consumption of grease decreases;
- in conditions of reasonable and correct operation, the LPG equipment inter-repair period is not less than 5 years;
- number of harmful emissions decreases [2].

1 Золотницкий В. А. Автомобильные газовые топливные системы. Москва, 2007. 128 с. Афонин С. Н. Газовое оборудование автомобилей. Легковые, грузовые. Устройство, установка, обслуживание. Практическое руководство. Ростов-на-Дону, 2001. 53 с.

2 Лиханов В. А., Деветьяров Р. Р. Применение и эксплуатация газобаллонного оборудования. Киров, 2006. 184 с.

Installing LPG equipment on the car has its drawbacks, the main of which is the equipment cost itself. At the same time:

- engine power decreases (propane-butane by 5%, methane up to 15%);
- fuel consumption increases by 10-20% (gas only);
- Dynamics deteriorates using the first and second generation of LPG equipment;
- LPG equipment above the second generation is not used on carburetor engines;
- improper installation and adjustment of LPG equipment lead to accelerated wear of the engine;
- strictly observe operating and maintenance modes;
- condensate from a gas reducer should be drained at least once per 10-12 thousand km of run;
- limiting (maximum) loads on the engine should be excluded;
- at present, there are fewer gas stations on the roads of Ukraine than gasoline gas stations;
- gas cylinders occupy the useful space of the trunk;
- increases the total weight of the car with LPG equipment.

Modern automotive equipment works on a mixture of liquefied petroleum gases (propane - butane: Liquified Petroleum Gas (LPG))or compressed natural gas (methane: Compressed Natural Gas, CNG) Therefore, forensic expert, in addition to thorough knowledge of the structure of automotive equipment and methods of its repair, should clearly distinguish between the types of LPG equipment installed on the wheeled vehicle and know its structure for further consideration in his expert work.

Propane is a gas produced while oil refining. Cylindrical or toroidal cans are used for propane. At present, there are cylindrical cans with an outer diameter of 200, 240, 270, 300, 315, 360, 400 and 450 mm and a volume of 10 to 230 liters. The most popular sizes installed on cars are 40, 50, 60, 90 liters. Cylindrical cans are mostly installed in luggage compartment (cars with a flat trunk floor), less often, under the floor of the luggage compartment (cars brands: *ZAZ-1102 Tavria, ZAZ-1103 Slavuta*, *VAZ-2121 Niva* and some other off-road vehicles). Toroidal cylinders correspond to the shape and size of spare tire that allows you install them instead of such a wheel. The most popular volumes are 40 and 42 liters (600 × 200 mm). There are internal, external and vertical toroidal cylinders. The weight of one propane can (depending on the volume) is 20-30 kg.

Methane is a natural gas, it is cheaper and more explosive than propane. Vehicle engine power drop in case of its use can be 10-15%. Methane is stored in cylinders withstanding a pressure of 200—250 atm. (can weight depending on the volume : 80—110 kg). At the same time, the cost of a set of methane equipment is twice to three times higher than that of propane one. Methane LPG equipment is more often installed on commercial cars and trucks that can carry massive cans (*GAZelle*, *GAZ*, *ZiL*, *URAL*, etc.), very rarely, on passenger cars.

Components and LPG equipment:

- gas cylinder
- pipelines
- gas charging valve and petrol valve
- gas dispenser and mixer;
- reducer-evaporator;
- electronic control unit;
- switch of fuel type.

Most often, forensic expert has to explore cars on which LPG equipment (propane — butane) is installed.

Forensic expert should distinguish between the generation of installed LPG equipment(propane — butane). They differ mostly in gas supply elements, control

systems and the possibility of installation on certain engines. The fuel systems of the gasoline engine have undergone three stages of modification. Over time, designers have improved the process of supplying fuel to the combustion chamber of the cylinders. Carburetor systems have been used for many years, but with the development of engine production, insufficient fuel supply to the carburetor has been revealed, which makes it impossible to achieve the desired power parameters. Engineers have developed an injector timing mechanism to increase engine power while saving fuel through electronic fuel control. At this stage, electronic control units were added. This has become the most primitive system of gas equipment using methane or propane. During installation, the cylinders are usually located in the luggage compartment, the fuel line is connected to the shut-off device, the gas passes through the line and enters the evaporation chamber connected to the cooling system. The heated gas mixture is fed to the gear dosing device. Initially, reducer and the evaporator chamber were considered separate units, but over time they were combined into one unit.

Gas is the most real alternative to gasoline and diesel fuel. Each kilometer traveled on gas costs on average a third cheaper than on gasoline, so it is clear that the basis of the transition to gas is the financial component. Previously, it was possible to experience large-scale savings: LPG equipment for primitive carburetor engines were cheap and propane-butane cost half as much for gasoline. Currently, the situation is different: in order to purchase gas equipment with a modern engine, you need a completely different level of components and qualifications of the master who will install it. In addition, along with the new safety requirements for cylinders, the installation of LPG equipment has led to a significant increase in the price of kits.

Recently, the use of liquefied gas as automotive fuel has become popular because it is cheaper than gasoline. However, there are also other advantages, for example, it is environmentally friendly than other types of fuel, its exhaust contains fewer harmful substances (in particular, CO_2 almost twice), gas has a higher octane number (103-105), which makes it almost impossible to detonate the engine. The wear of the cylinder-piston group of internal combustion engine decreases on the gas:

- while starting cold engine, a film of gasoline is not formed that washes away lubrication;
- the gas burns more slowly, as a result, pressure in the cylinders does not increase so quickly and the shock loads on the engine parts due to better mixture of gas and air are less than gasoline;
- gas mixture is more evenly distributed by cylinders, that improves engine idling, it works softer and quieter;
- after starting a cold engine on gas, it is possible to go almost immediately, no long-term heating is required (as on gasoline);
- gas does not thin the motor oil, so it can be changed less often than using gasoline;
- almost no soot will form, gas compared to gasoline is much cleaner, so dirt does not get into the carburetor.

The disadvantages of gas include less heat of combustion, so the engine power per gas is less by about 5 %, so sometimes it is advised to install another ignition. However, this is a controversial issue, firstly, it is advisable to work only on cars

running on high-octane gasoline (more than 95) so that you do not have to put ignition later whenever you need to go on gasoline. Secondly, there is an opinion that at high speeds while working on gas, on the contrary, ignition should be somewhat later than for gasoline.

Many of LPG equipment shortcomings are controversial. For example, while installation holes for mounting the cylinder are drilled in the body, a gas line is attached under the bottom and a reducer is installed under the hood. In a few years, mounting sites can become centers of corrosion, so you need to worry about the corrosion treatment of all mounting holes. If you insert the so-called "tablet" instead of a cylindrical can, it will take the place of a spare wheel that has nowhere to go (or not to carry it at all, or to carry it in the trunk). Opponents of gas installation say there is a high probability of a cylinder exploding that is usually an exaggeration. The facts of the cylinder explosion on the territory of the eastern regions of Ukraine in recent years have not been recorded. Gas cylinder is stronger than the gasoline tank, in addition, there are protective valves and mechanisms that are triggered in the event of a gas leak.

There are certain reservations about installing LPG equipment on turbine engines. The gas has a higher combustion temperature, so the exhaust temperature increases the thermal load on the turbine impeller and affects the resource of the exhaust valves. Catalysts have temperature restrictions that are available in most gasoline engines. In the catalyst should burn everything that is not burned in the cylinder. In high temperature conditions, catalyst begins to melt (especially during high engine speeds) and blocks the exhaust. During low and medium speeds LPG equipment does not damage the motor.

There is an opinion that the gas dries the engine, it should not be installed on expensive cars. This is true, but such a process occurs only at high speeds (more than 4000 rpm). To minimize the consequences, install a gasoline injection. Under the influence of the load, the engine heats up, and gasoline contains oils that are absent in the gas. Therefore, after installing LPG equipment over time, the smell of gas can appear, even if the connections are completely sealed. This is because rubber hoses (pipelines) are impregnated with fumes. In the case of the use of high-quality hoses (pipelines), such a problem will not be.

There is also an opinion that LPG equipment for cars is beneficial only to those who have large engines. Therefore, we calculated the feasibility of installing LPG equipment (for example, on the car Skoda Fabia 2002 model year), that travels an average of 1000 km per month. Suppose that in a city 100 km it needs 8 liters of gasoline and gas consumption of 15-20 % more than gasoline (10 liters of gas per 100 km). If 1 liter of A-95 gasoline costs UAH 62, and gas - UAH 40, then to ride on gasoline for a month, you need to spend about UAH 5,000 (for gasoline) and UAH 4,000 (for gas), i.e. monthly savings of UAH 1,000. If you install a new Italian LPG equipment of the fourth generation that costs about 12,000-13,000 UAH, it will pay off in a year. If you drive more, then faster. LPG equipment maintenance (air filter replacement, computer diagnostics) is best performed after every 10,000 km of mileage where it is installed (these services cost up to UAH 500), even at such costs the savings are obvious. It should be noted that in the case of low mileage, the installation of LPG equipment is advantageous. If the equipment works properly, the cost of its maintenance will be moderate, and fuel savings will cover them.

Another advantage is a double range: if the gas runs out, you can go on gasoline (this is convenient during long-distance travel and is relevant in queues at gas stations or fuel shortages).

For classifying the types of gas cylinder equipment in Ukraine, the *generation* term is used (the larger it has a number, the more complex and perfect it is). At the same time, there is some confusion in the qualifications of generations (more precisely in its numbering). The difference lies primarily in the method of controlling the supply of gas into cylinders and the corresponding design nuances, so in order to avoid confusion, LPG equipment can be divided into carburetor and injection engines.

For carburetor engines, the systems of the first and second generation today are understood as LPG equipment with vacuum-mechanical regulation of gas supply. The dosing diaphragm in the evaporator gearbox as the initial information takes into account the liquefaction in the intake manifold, depending on the load on the engine and the position of the throttle. Such equipment was created primarily for carburetor engines, although some modifications of the 2nd generation LPG equipment are put on budget injector cars. These systems are simple, unpretentious, reliable and affordable, although they have a disadvantage, namely: higher gas consumption compared to modern systems.

Currently, it is difficult to find a set of vacuum-controlled LPG equipment in high-quality design, since it is considered obsolete.

The first attempt of designers to involve electronics for injection engines to control two-fuel power supply systems were control systems for oxygen sensor combustion of fuel and regulation of fuel supply by a stepper motor. Such systems are often called the third generation, they were intended for injection engines (mono-injection), although with some modifications they were mounted on carburetor engines. The gas in the engine of this generation changes from the liquid phase to the gaseous phase in the gearbox, but the control of the fuel metering is no longer responsible for the vacuum, but electronic unit, that takes into account data from the lambda probe, engine sensors and throttle position. Actually the gas is measured by a mechanical step batcher, to the cylinders it is fed by the mixer established on a throttle valve. Quite complex and expensive, but insufficiently economical equipment of this type has not taken root, giving way to the next, fourth generation.

Currently, the most common are gas injection systems that completely inherited the principle of gasoline supply in cars with a classic distribution of injection. Electromagnetic gas injectors (individual for each cylinder) are inserted into the intake manifold, which are controlled by an electronic unit intercepting the signals coming to the gasoline injectors from the standard electronic engine control unit. The gas reducer, pipelines, shut-off valves and cylinder are almost indistinguishable from the units of previous generations. Such gas injection today can be considered the most rational in terms of combining price, design and gas consumption. Properly set up 4th generation LPG equipment systems (this type is the most common in Ukraine) consume only 10-15% more gas than gasoline. The main disadvantages of

these systems are the high price (two to three times higher than LPG equipment with vacuum control) and the need for equipment to fine-tune the system on the car. In addition, it is necessary to choose components of only reputable brands and install LPG equipment in specialized workshops.

There are also more modern systems: the fifth generation, using gas injection, but with one significant difference: liquefied gas is not converted into a gaseous state, the car consumes it in the same form in which it is stored in a cylinder (liquid). The pump, located in the cylinder, injects liquid gas in the main and further to the injectors, which inject it into the intake manifold opposite each cylinder. Alternatively, on engines with direct fuel injection, it is possible to inject gas through the petrol injectors directly into the cylinder. But such a system additionally uses an expensive module for switching the supply to the injectors of gasoline or liquefied gas. As in the petrol mode of operation, injection of liquid propane-butane is controlled by electronics. And to regulate the proper combustion of liquid gas using software created specifically for a particular engine model. As a result, such a system responds more quickly to changes in load and, thanks to accurate dosing, consumes more fuel (gas at the gasoline level). LPG equipment kit with injection is more demanding on gas quality and level of service.

First generation of LPG equipment

Reducers for the first generation of LPG equipment can be of two types: vacuum and electronic. A significant disadvantage of gas systems of this generation is the so-called “long way” of gas to the combustion chamber, as a result of which depressurization often occurred and as a result a strong smell of gas in the interior of the vehicle. Such systems were cheap, manufacturers saw that the systems were in demand and began to improve them. The simplest injector (without lambda probe) LPG equipment, that has a vacuum control and a mechanical gas dispenser, can be installed on carburetor engines. The fundamental difference between an electronic reducer and a vacuum reducer is the principle of operation of the shut-off element of the discharge chamber (in a vacuum reducer this work is performed by a special vacuum membrane, which is supplied with a vacuum from the intake manifold). This obsolete type of gas equipment is very rare nowadays.

The first generation systems meet the outdated environmental requirements of Euro 1, so it was banned in Ukraine back in 2006 (although sometimes continue to be installed until now). The second-generation gas installation can be installed on vehicles that have driven for more than 25 years. The third generation of LPG equipment hardly anyone installs, such an installation can be found only on machines driven from Europe.

Second generation of LPG equipment

The next generation differs slightly from the first one, the gearbox is upgraded (in particular, the shut-off valve has become electromagnetic, and not vacuum, as before). Now the driver does not need to leave the car to switch to another type of fuel, because there is a special button in the cabin to switch the type of fuel, that is, it is more convenient to operate the HBO. In addition, a cold start has been implemented: a small

amount of gas is released before the system is let in, which further ensures easy start of the cold engine. It has become possible to use the gas system on injector-type engines of the first generation of spray injection or mono-spraying. This generation of HBO is installed on a vehicle with lambda probe and catalytic converter injector engines as well as a catalytic converter.

Third generation of LPG equipment

Third generation of LPG equipment includes electronic adjustment of the gas supply to the combustion chamber. The system reads data from the oxygen sensor and adjusts the amount of gas received by the engine using a stepper motor. The temperature sensor located on the gearbox monitors the minimum temperature. When the reducer is heated above the minimum temperature, the controller switches on the gas supply. This generation of LPG equipment meets Euro 2 standards by reading data from the oxygen sensor and electronically adjusting the fuel supply. LPG equipment is supplied with its own correction system, but the reaction rate to adjust the working mixture is limited by the speed of the step dispenser. The mode of operation simulating of nozzles and the lambda probe is used for uninterrupted operation of the standard control system.

In this system, the gas is supplied individually by the dozer (gas injector) to each cylinder of the engine. The electronic unit controls the gas injector. The gas is supplied to the intake manifold through mechanical nozzles automatically opened by the overpressure that occurs in the supply line. Instead of the dosing gas register (as in the LPG equipment-1 and LPG equipment-2 systems), a gas motor and a special electronic control unit are installed to regulate the quality of the air-gas mixture composition. This innovation made it possible to almost eliminate the possibility of sudden loud noises completely. Disadvantages of this generation of LPG equipment: slow system response to changes in the engine operating mode of the vehicle.

The third generation systems meet the of Euro 2 requirements .

Fourth generation of LPG equipment

Fourth LPG equipment generation, the fuel supply has changed dramatically, gas injectors have appeared that inject gas into the cylinders. The gearbox does not inject fuel into the manifold, which allows it to maintain a constant gas pressure (excess pressure is removed by gas injectors). Each individual nozzle has its own cylinder. The injectors have their own loops directed from the controller, which gives the command to inject fuel to each injector, so it happens in a certain period of time. In the methane versions of the 4th generation of LPG equipment, not only the reducer but also the cylinders have been changed (thick-walled ones are used due to the high methane pressure). The gas supply for each cylinder is separate, which allows you to significantly increase the speed of response to the adjustment of the gas-air mixture and optimize engine performance. This is the best known technical solution for the moment.

Fourth generation of LPG equipment is the most common, it is the most economical and reduces the power of the car the least (up to 10%), although it requires the gearbox to be well warmed and the gas to be warm. It is installed on any injector vehicles, as well as vehicles

with new on-board diagnostic systems (EOBD, OBD II).

An important feature and advantage of LPG equipment-4: the function of automatic transition from gas to gasoline and vice versa (if the gas cylinder has become empty). This type of gas injection removes the problem of sudden loud noises and requires less attention to the air filter and spark plugs of the working mixture, gas consumption is as close as possible to gasoline consumption.

The basis of safety is availability of a multi-valve on the gas cylinder.

The expert should pay attention to the electronic control unit of the gas cylinder equipment. They differ in a set of adjustable parameters and can have an automatic adjustment or auto-calibration function that allows to set the optimal operating modes. Modern electronic complexes (for example, *King, Lovato, OMVL, Zavoli,* etc.) have maximum automation during adjustment of equipment and practically do not require the professional participation.

The Fourth generation systems meet the of Euro 2 requirements .

Fifth generation of LPG equipment

In all precursors, the gas was supplied to the combustion chamber in the gaseous state, in the 5th generation of LPG equipment in liquid state, in addition, the fuel pump in the cylinder pressurizes the system. Advantages of this generation of LPG equipment: the lack of a gearbox, there is no need to preheat the car with gasoline, nothing more interferes with the cooling system, gas costs have significantly decreased, the number of pipelines in fuel lines has been reduced to a minimum, the capacity of riding on gas has significantly increased. However, it has become impossible to refuel methane, because this gas comes in liquid form (a temperature below 160 °C is necessary for methane to liquefy).

The fifth generation of LPG equipment is compatible with EOBD, OBD II and OBD III on-board diagnostic systems, it uses the computing power of the vehicle and can be used in any engine with fuel injection. A gas pump is installed in the HBO cylinder together with the multi-valve that starts operating after opening the vehicle door (this creates a gas pressure of approximately 15—16 atm in the mains during the engine start). Instead, there is no gas reducer and no additional gas filter. The gas enters each cylinder separately through electrospray nozzles located in the intake manifold as close as possible to the cylinders. An important difference is the ingress of gas into the cylinders in the liquid state, which reduces the loss of engine power and gas consumption and allows the engine to run on gas under subzero ambient temperatures.

It should be noted that these systems are very complex and sensitive to the quality (purity) of gas. The cost of LPG equipment-5 is about 30% more expensive than LPG equipment-4. The fifth generation systems meet the requirements of Euro 3 and Euro 4.

Sixth generation of LPG equipment

This is a generation of gas cylinder equipment designed for direct fuel-stressing engines that is not yet widespread. In the 6th generation systems, there is no distinction between gas and gasoline injectors, the gas supply is cut into the regular gasoline supply system (the difference is only in two different tanks: gasoline and gas). The equipment has been eased to the maximum.

The gas supply system is similar to the previous generation, the main difference of the direct injection from the distributed is the placement of the nozzles (in the first case, directly in the head of the engine block, in the second, on the ramp in front of the intake manifold).

LPG equipment-6 is installed on gasoline engines such as TSI, FSI, TFSI, because this system does not require additional cutting of gas nozzles to the intake manifold of the engine (gas enters through gasoline nozzles). In the trunk there is a gas cylinder with a built-in pump that maintains a pressure of about 16 atm in the main (pipeline). There are two main lines — the main line and the return line, with which the residual gas is returned to the cylinder. A controller controlled by electronics is cut into the gasoline fuel supply system, it cuts off the gas/gasoline supply. Therefore, this allows LPG equipment-6 to minimally interfere with the original vehicle electronics and fuel injection system.

The sixth generation systems meet the of Euro 2 requirements.

Seventh generation of LPG equipment

For a long time, LPG equipment of the 4th generation with gasoline spraying was installed on engines with direct fuel injection. This was due to the fact that gasoline nozzles are close to the combustion chamber and require cooling, which is provided by the gasoline mixture. If the nozzles are not cooled, they will quickly fail, requiring expensive repairs. *Vialle* professionals have developed a new system for direct-injection vehicles which is that fuel is supplied by a standard gasoline injector, but there is no gas at all.

The basis of the 7th generation Direct Blue LPG equipment system is the FSU fuel mixing module, which providing smooth switch between gasoline and liquefied gas. The size of such a module is about the size of a medium battery, its purpose is to create a pressure similar to gasoline and deliver fuel to the injectors.

While system installation, the foreman does not interfere with the engine control system ensuring reliable operation in any mode and maintaining the strength at the same level as on gasoline. The 7th generation LPG equipment makes possible to operate the car only on gas without using gasoline at all, even the engine can be started on gas at any time of the year.

The LPG equipment kit is selected for a specific vehicle model, the software is rigidly linked to the engine code. This generation of HBO unit is quite advantageous because it retains the power of the vehicle, has a simple system design (because there is no reducer-evaporator and gas nozzles), and it is quickly mounted (because there is no reducer, this does not require intervention in the cooling system).

Having analyzed the automobile market of Ukraine, it can be concluded that a large majority of modern vehicles with LPG equipment are represented by fourth-generation equipment. Therefore, while technical inspection of the test wheeled vehicle, the expert commodity expert, in addition to the vehicle itself, must make a photo fixation and recording in the inspection report of the type of LPG equipment, date of its installation (indicated in the certificate of registration of the vehicle in the section of special marks), operability and main components of the kit.

As an example, we will give the components of the most massive *Stag 200 GoFast* kit:

- gas cylinder with a multi-valve (type, content, with or without a quantity indicator, method of placement and fastening);
- filling valve (placement);
- gas main (pipeline type);
- *Stag-4 GoFast* electronic control unit;
- gas reducer (its brand and fasteners);
- nozzles with vents (number, type and location);
- gas vapor phase filter (metal housing);
- choke in the manifold;
- switch of fuel type with indication of gas cylinder filling level.

After checking the completeness and integrity of the LPG equipment, if possible, start the engine of vehicle and check its operation on gasoline and gas.

To date, the most commonly encountered LPG equipment brands are STAG Autogas, PRINS VSI, BRC, Vialle LPI, ZENIT, KME, TOMASETTO.

While drawing up the forensic expert conclusion, it is necessary to adjust the cost of the vehicle in accordance with the information given in the "Bulletin of the commodity expert" taking into account the period of its operation. When calculating the cost of repairing the damaged vehicle, forensic expert should take into account the volume and cost of dismantling/installation and adjustment of the LPG equipment and the cost of its individual damaged components.

Conclusions

The article analyzes modern types of LPG equipment and presents the features of the expert's actions during the study of vehicles with such equipment.

These data will help experts to understand the types of LPG equipment of modern wheeled vehicles and to understand the peculiarities of the sequence of work during the expert inspection of such vehicles.

Особливості дослідження експертом колісних транспортних засобів із газобалонним обладнанням

Сергій Науменко, Володимир Бражник, Іон Санду

Розглянуто питання газобалонного обладнання, яке встановлюють та експлуатують на сучасних транспортних засобах, а також його різновидів, особливостей будови та комплектації.

Метою статті є ознайомлення з різновидами газобалонного обладнання сучасних автомобілів і визначення особливостей дослідження під час експертного огляду таких транспортних засобів.

Наведено порядок дій експерта під час проведення технічного огляду досліджуваного колісного транспортного засобу. Зауважено про необхідність ураховувати наявності газобалонного обладнання під час визначення ринкової вартості транспортного засобу, відновлювального ремонту та матеріального збитку, завданого власникові автомобіля.

Розглянуто переваги й недоліки, із якими стикаються власники автомобілів зі встановленим газобалонним обладнанням. Докладно розглянуто класифікацію газобалонного обладнання, зазначено розбіжності під час установлення газобалонного обладнання на карбюраторні й інжекторні двигуни.

Ключові слова: *судовий експерт; газобалонне обладнання; складові газобалонного обладнання; газоповітряна суміш; екологічні вимоги; експертний огляд колісного транспортного засобу.*

Особенности исследования экспертом колёсных транспортных средств с газобаллонным оборудованием

Сергей Науменко, Владимир Бражник, Ион Санду

Рассмотрены вопросы газобаллонного оборудования, которое устанавливают и эксплуатируют на современных транспортных средствах, а также его разновидностей, особенностей строения и комплектации.

Целью статьи является ознакомление с разновидностями газобаллонного оборудования современных автомобилей и определение особенностей исследования при экспертном осмотре таких транспортных средств.

Приведён порядок действий эксперта при проведении технического осмотра исследуемого колёсного транспортного средства.

Обращено внимание на необходимость учитывать наличие газобаллонного оборудования при определении рыночной стоимости транспортного средства, восстановительного ремонта и материального ущерба, причинённого владельцу автомобиля.

Рассмотрены преимущества и недостатки, с которыми сталкиваются собственники автомобилей с установленным газобаллонным оборудованием. Подробно рассмотрена классификация газобаллонного оборудования, отмечены различия при установке газобаллонного оборудования на карбюраторные и инжекторные двигатели.

Ключевые слова: *судебный эксперт; газобаллонное оборудование; составные газобаллонного оборудования; газовоздушная смесь; экологические требования; экспертный осмотр колёсного транспортного средства.*

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The authors declare that they have no conflict of interest.

References

Afonin, S. N. (2001). *Gazovoe oborudovanie avtomobilei. Legkovye, gruzovye. Ustroistvo, ustanovka, obsluzhivanie. Prakticheskoe rukovodstvo* [Gas equipment for cars. Cars, trucks. Arrangement, installation, maintenance. How-to]. Rostov-na-Donu [in Russian].

Likhanov, V. A., Devetiarov, R. R. (2006). *Primenenie i ehkspluatatsiia*

gazoballonnogo oborudovaniia [LPG equipment application and operation]. Kirov [in Russian].

Zolotnitskii, V. A. (2007). *Avtomobilnye gazovye toplivnye sistemy* [Car gas fuel systems]. Moskva [in Russian].

Naumenko, S., Bragnik, V., Sandu, I. (2022). Features of forensic research on wheeled vehicles with LPG equipment. *Theory and Practice of Forensic Science and Criminalistics.* Issue 1 (26). P. 95—107. DOI: 10.32353/khrife.1.2022.06.

Challenging issues of performing forensic economic examinations of reports on independent expert valuation of asset value

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The article is dedicated to methodological principles of conducting forensic economic examinations of reports on economic measurements that are performed through methods of assets independent valuation. The Article Purpose is to stress challenging issues arising while forensic economic examinations to identify indicators of assets value obtained as a result of economic measurements through methods of assets independent valuation. The problematic issues of substantiation of the method of quantitative measurement of the degree of uncertainty concerning valuation results based on the probabilistic metrological approach that is rooted in application of the interval form of valuation results presentation are outlined. A comparative analysis of the requirements of national and international valuation standards for description of valuation results uncertainty is carried out. It has been demonstrated that when applying comparative and income approaches, indicators of uncertainty for requested confidence levels in the form of numerical values of the confidence interval limits can be established on the grounds of statistical processing of multiple data of market information series (in particular, adjusted single indicators of offers for sale or rental rate of such property).

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Peculiarities are presented and conditions of correctness for performing these economic measurements are formulated.

Keywords: *independent expert valuation, forensic economic examination of report, economic measurements, error, accuracy, reliability, uncertainty of valuation result.*

Research Problem Formulation

While forensic economic examination of reports on independent expert valuation of property value, the forensic expert is frequently asked about the reliability of valuation results; correctness of performance and completeness of disclosed information in the report on valuation procedures; compliance with requirements of the current regulatory framework (in particular, National Standards (hereinafter referred to as NVS) [1] of independent valuation); market value of valuation object at a specified valuation date. The answer to the last question presupposes conducting a re-valuation by a forensic expert based on which judgments are formulated regarding the accuracy of valuation in a report under study and reliability of its results.

Such issues demand not only a comprehensive research and analysis of the report but also a full-fledged valuation by a forensic expert. According to paragraph 1.4 of Scientific and methodological recommendations on preparation and appointment of forensic examinations and expert research [2], "during forensic examinations corresponding research methods, methods of forensic examinations as well as legal regulations and regulatory documents (international, national and industry standards) are used". That is, examination of independent valuation reports should be grounded on the same valuation standards that guide independent appraisers. But the problem of interpreting results of such work and, in particular, their correlation with results of a studied report is insufficiently outlined in the professional literature.

Unfortunately, currently there are no tested, approved and entered in the Register methods of forensic examinations to determine quantitative indicators of reliability of independent expert valuation results. Thus, judgments on results reliability of the analyzed report are obtained on the basis of creative heuristic approaches to the development of research methods that obviously necessitates application of scientifically sound principles. This sometimes exceeds capacities of an average forensic expert and goes well beyond the issues addressed to him. Most often, an expert research of

1 Про затвердження Національного стандарту № 1 «Загальні засади оцінки майна і майнових прав» : Постанова КМУ від 10.09.2003 р. № 1440 (зі змін. та допов.). URL: https://zakon2.rada.gov.ua/laws/show/1440-2003-п (date accessed: 17.12.2021) ; Про затвердження Національного стандарту № 2 «Оцінка нерухомого майна» : Постанова КМУ від 28.10.2004 р. № 1442 (зі змін. та допов.). URL: https://zakon5.rada.gov.ua/laws/show/1442-2004-п (date accessed: 17.12.2021).

2 Інструкція про призначення та проведення судових експертиз та експертних досліджень : затв. наказом Мін'юсту України від 08.10.1998 р. № 53/5 (у ред. наказу від 26.12.2012 р. № 1950/5). *Офіційний вісник України.* 2013. № 3. ст. 91.

a valuation report is limited to a fairly formal analysis of compliance with the requirements of the current regulatory framework. Though it is necessary, still insufficient for obtaining a reasonable unbiased judgment about the quality of performed economic measurements in a forensic report. As a consequence, while forensic economic examination and review of reports, fundamental issues of methodology for developing indicators of reliability and accuracy for results valuation are frequently overlooked. This situation urgently requires the development of unified, scientifically sound methods of adopting these indicators. They must be objective and quantitative, that is be independent from the subjective viewpoint of the forensic expert or reviewer.

Given the above, the issue of studying theoretical foundations of methods for establishing quantitative indicators of reliability and accuracy of results of economic measurements performed through methods of independent expert valuation is highly relevant. It is of great practical importance for the creation of a reliable evidence base in both civil and criminal proceedings. Occasionally, appraisers are accused of failing to cover (as well as commodity, land appraisal, construction appraisal and construction-technical examinations to determine the value) problematic issues of establishing indicators of reliability and accuracy of conducted independent valuation in conclusions of forensic economic examinations. This is the result of the lack of methodology and incompleteness of expert conclusions required to create a reliable evidence base. Concentrating on the research on reliability and accuracy of valuation results would enhance efficiency and ensure the quality of forensic economic examination, would help to separate professional judgments of the appraiser for which he is responsible from possible expanded interpretation of obtained valuation result the appraiser is not responsible for.

Article Purpose

The Article Purpose is to stress challenging issues arising while forensic economic examinations to determine indicators of assets value obtained through economic measurements by methods of independent expert valuation; research and interpretation of theoretical provisions and substantiation of practical guidelines for the development of heuristic methods for establishing objective quantitative indicators of the degree of uncertainty of valuation result; justification and selection of methodological approaches before determination of quantitative values of these indicators at the stage of valuation or at any date after their completion; interpretation of results acquired during valuation; analysis of possibilities to increase the objectivity of results of expert research of independent expert valuation reports and formulation of practical guidelines regarding priority areas of their analysis.

Analysis of Essential Researches and Publications

During forensic economic examinations of independent expert valuation reports, it is crucial to take into account the effect of uncertainty on economic measurements result. V. V. Lukianova's [3] research paper addresses peculiarities of

3 Лук'янова В. Дуалізм невизначеності та ризику в економічних явищах. *Вісник Хмельницького національного університету*. 2017. № 2 (2). С. 216—220. URL: https://nbuv.gov.ua/UJRN/Vchnu_ekon_2017_2%282%29__46 (date accessed: 17.12.2021).

causes of uncertainty and risk, provides a hierarchy of types of uncertainty in economic measurements and suggests a systematization for types of economic uncertainty. Having analyzed problems of uncertainty in economy, the author distinguished between four main classification features of economic uncertainty: 1) the level of information awareness in a person making a decision; 2) the probability level of events occurrence; 3) the nature of uncertainty (in particular, time uncertainty associated with forecasting; metric uncertainty related to inaccuracy of valuation or measurement of variables; structural uncertainty); 4) measurability indicator that is determined by existing methodology capabilities, computing base and peculiarities of random market processes.

One of the most powerful sources of uncertainty while performing economic measurements is market uncertainty conditioned by informational nature of the market and probabilistic nature of market mechanisms [4] functioning. It is impossible to imagine a situation in which the impact of uncertainty in the external marketing environment [5] can be fully localized, since in practice it is impossible to take into account and reasonably assess levels of all market risks affecting valuation results [6]. Credible measurement of risks during economic measurements is not always possible, as the researcher may not be aware of all sources of uncertainty as well as quantitative estimates of their weighting coefficients [7]. For economic measurements performed by methods of independent expert valuation, the statements from paragraphs 3.1—3.3 of this document [8] are valid. As with measurement of any other quantities, in this case the purpose of measurement is to provide information about the measured quantity (the value of valuation object). No measurement is infallible, that's why when measuring the value quantity, the value obtained depends on used source data, measurement methods, qualification and skills of the performer, current market conditions, etc. Even if this quantity is measured several times in the same way and under the same conditions, in most cases each time the result will vary. Such values of results of valuation performed by different performers are viewed as options for random implementation of estimates of the measured quantity. The values span of estimates depends on how

4 Поздняков Ю. В. Невизначеність результату незалежної експертної оцінки : монографія. LAP Lambert Academic Publishing, 2021. 472 с.

5 Литвиненко Т. М. Невизначеність ринкового середовища та шляхи її локалізації. Теоретичні та прикладні питання економіки : зб. наук. пр. КНУ ім. Т. Г. Шевченка. 2009. Т. 19. С. 46—55. URL: https://tppe.econom.univ.kiev.ua/data/2009_19/zb19_07.pdf (date accessed: 17.12.2021).

6 Жадан Т. А., Жадан Ю. В. Сучасні наукові підходи до розуміння економічного змісту поняття «ризик». Причорноморські економічні студії. 2018. Вип. 33. С. 74—78. URL: https://nbuv.gov.ua/UJRN/bses_2018_33_17 (date accessed: 17.12.2021) ; Вітлінський В. В., Великоіваненко Г. І. Ризикологія в економіці та підприємництві : монографія. Київ, 2004. 480 с.

7 Балджи М. Д. Економічний ризик та методи його вимірювання : навч. посіб. Харьків, 2015. 300 с. ; Вітлінський В. В., Наконечний С. І., Шарапов О. Д. Економічний ризик і методи його вимірювання : підручник. Київ, 1996. 336 с.

8 Введение к «Руководству по выражению неопределенности измерения» и сопутствующим документам. [Introduction to "The guidelines for the expression of measurement uncertainty" and relevant documents.] Оценивание данных измерений / пер. с англ. ; под науч. ред. проф. В. А. Слаева, А. Г. Чуновкиной. Санкт-Петербург, 2011. 58 с.

well measurement is performed. Their average value should ensure an estimate of the true value of a quantity that is generally more reliable comparing to the individual result of a single measurement. Variance and number of results of valuation provide information regarding the average value as an estimate of the true value of the measured quantity, but this information is mostly insufficient. International Valuation Standards (IVS) devote substantial attention to the disclosure of uncertainty while valuation [9].

In the modern metrological concept of uncertainty, it is generally accepted that after performing any measurements, there is always uncertainty about the truth of a delivered result; doubts as to how accurately the measurement result reflects the value of the measured quanity. For example, in case of a single measurement, the result may coincide with the conditionally true value of the measured quantity, i.e. there may be zero errors. But it is impossible to prove, that's why uncertainty as a measure of lack of confidence in the obtained result may be essential, since it reflects the possible scattering of a series of measurement results. In the approach from the standpoint of uncertainty, the true value concept is now abandoned, because it not only can not be known but does not exist at all in the probabilistic approach. The conventional true value in the concept of uncertainty can be expressed only in a certain range (for example, the confidence interval), since as we approach conventional true value (with a decrease in uncertainty), it is essential to take into account more factors that influence [10].

The efficiency of forensic economic examination and effectiveness of its interaction with forensic investigators depend in particular on the development of the applied theoretical and methodological framework. The latter is impossible without the use of scientifically sound approaches, as this examination applies specific expertise regarding economic area of human activity [11]. Specific expertise required to perform a forensic examination is the result of professional training and professional education of certain persons who are holders of this knowledge. Its use is stipulated only by certain subjects and in particular procedures. In each case it requires the existence of one of the subjects provided by law, certification of his / her professional competence and the use of legal ways to obtain research results. A forensic report as an independent forensic evidence in a case can only be the result of a forensic examination appointed and conducted in strict compliance with the requirements of procedural law. The forensic report obtained outside the process or in violation of requirements for the form, content, status of a forensic

9 Гаража О. П. Стандартизація оцінки майна у світі. *Науковий вісник Міжнародного гуманітарного університету. Серія «Економіка і менеджмент»*. 2016. Вип. 17. С. 36–42. URL: https://nbuv.gov.ua/UJRN/Nvmgu_eim_2016_17_10 (date accessed: 17.12.2021).

10 Василенко І. Ф. Вплив концепції невизначеності вимірювань на метрологічну діяльність. *Наукові записки*. 2016. Вип. 19. С. 58—68. URL: https://dspace.kntu.kr.ua/jspui/bitstream/123456789/4329/1/5__19_2016-59-69.pdf (date accessed: 17.12.2021) ; Чалый В. П. Неопределенность и погрешность, их сходство, различие и употребление в разных метрологических процедурах. *Системи обробки інформації.* 2006. Вип. 7 (56). С. 82—85. URL: https://nbuv.gov.ua/UJRN/soi_2006_7_27 (date accessed: 17.12.2021).

11 Горлачук О. А. Теоретико-методологічні засади судової економічної експертизи. *Теорія та практика судової експертизи і криміналістики*. 2021. Вип. 23. С. 300—310. DOI: 10.32353/khrife.1.2021.23 (date accessed: 17.12.2021).

expert, does not acquire the status of forensic evidence [12]. Therefore, it seems expedient to more clearly circle the range of persons: holders of specific expertise who have legal rights and grounds to be subject to procedural obligations for practical application of this knowledge in forensic economic examination of asset valuation reports in accordance with corresponding legal responsibility. Until 2020, the concept of specialist conclusion as a source of evidence in the current criminal procedural legislation of Ukraine was not provided. The Law No 2617-VIII [13] of 22.11.2018 introduced the concept of specialist conclusion in the criminal procedure in cases when at the stage of inquiry it is required to set actual data and circumstances of a criminal offense by applying specific expertise. This Law, Part 4 of Article 71 of the Criminal Procedural Code of Ukraine was supplemented by a Provision on the right of a specialist: "... 7) to provide conclusions on issues within the scope of his expertise while pre-trial investigation of criminal offenses" [14]. The introduction of the *specialist conclusion* concept in criminal proceedings helps to enhance efficiency of forensic science institutions. This enables them to involve forensic experts who do not work in forensic science institutions (hereinafter referred to as FSIs) and also can improve the quality of expert support of justice by conducting a forensic examination, which is issued as a forensic report or specialist conclusion. Thus, in civil and criminal proceedings, a specialist can be any person who possesses specific expertise and skills in the relevant field and can provide assistance and conclusions while pre-trial investigation or trial on issues requiring corresponding specific expertise and skills. In the unavailability of approved methods for determining quantitative characteristics of uncertainty of valuation results, specialists in relevant fields of knowledge (appraisers with corresponding expertise and work experience; members of expert councils; representatives of professional self-regulatory organizations of appraisers; scientists in metrology) may be involved in such forensic examinations. These people are holders of specific expertise, they have the right to provide a specialist conclusion and take part in a appropriate proceeding [15]. After all, the current legal framework enables to include the specialist's advisory conclusion in case materials in civil and criminal proceedings based on Article 103 of the Civil Procedural Code [16] and Article 71 of the Criminal

12 Васильєв В. М. Судова експертиза у цивільному та господарському провадженні як окрема форма застосування спеціальних знань. *Теорія та практика судової експертизи і криміналістики*. 2020. Вип. 21. С. 120—132. DOI: 10.32353/khrife.1.2020_08 (date accessed: 17.12.2021).

13 Про внесення змін до деяких законодавчих актів України щодо спрощення досудового розслідування окремих категорій кримінальних правопорушень : Закон України від 22.11.2018 р № № 2617-VIII (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/2617-19 (date accessed: 17.12.2021).

14 Сімакова-Єфремян Е. Б. До питання про введення у кримінальне процесуальне законодавство поняття «висновок спеціаліста». *Теорія та практика судової експертизи і криміналістики.* 2020. Вип. 20. С. 110—120. DOI: 10.32353/khrife.2.2019.07 (date accessed: 17.12.2021).

15 Ріпенко А. Правові засади проведення судової експертизи / Ліга. Блоги. URL: https://blog.liga.net/user/aripenko/article/25443 (date accessed: 17.12.2021).

16 Цивільний процесуальний кодекс України від 18.03.2004 р. № 1618-IV (зі змін. та допов.). Відомості Верховної Ради України (ВВР). 2004. № 40—41, 42. Ст. 492. URL: https://zakon.rada.gov.ua/laws/show/1618-15 (date accessed: 17.12.2021).

Procedural Code of Ukraine [17]. This direction of combining efforts of forensic experts and specialists can enhance the quality of examination and contribute to the establishment of cooperation between specialists in the development and improvement of the methodological base of expert researches.

Traditional metrological approaches can be used to determine quantitative characteristics of uncertainty of results of economic measurements, and error [18] estimation can be used to quantify the degree of uncertainty. Depending on the sources of uncertainty and a relevant component of an error of the valuation result, these errors can be divided into two groups: errors from uncertainty used to evaluate information and errors from imperfection of valuation methodology. Errors of the first group are manifested in the fact that source data of market information are probabilistic in nature and characterized by variation in certain intervals. The errors of the second group are caused by imperfections and incomplete adequacy of estimation methods, accepted assumptions and limitations, as well as simplified mathematical formulas, results of calculations based on them are approximate and often do not give a sufficiently accurate description of real economic phenomena and processes. Examples of the impact of limited assumptions are, for example, assumptions about the stability of dollar asset prices; about the proportional relationship between their value and a certain pricing factor; about the possibility of determining overhead costs as a percentage of wages, etc. This group of errors also contains possible calculation errors (including rounding). Estimates of random and systematic errors always contain an element of subjectivity. The appraiser makes subjective errors involuntarily (due to limited qualifications, inattention, haste) or intentionally (due to interest, bias or external pressure of a customer). Only an appraiser's adherence to professional ethics can tell him how far he can go in his compromises with his conscience, influencing the final result of valuation. In the literature, one can find quite contradictory information about the achieved accuracy of results of economic measurements, errors in which, according to S. V. Hrybovskyi, range from 5 to 25 %, and sometimes even more. Thus, cost of products sold is measured to an error of 3—5 %, and source data — 10—20 %. Errors in integrated calculations of feasibility studies sometimes reach 30% [19]. According to the results of research on the value of the most expensive brands in the world performed by well-known companies at one single date, numerical indicators of the relative error of valuation results range from 22 to 50% [20].

17 Кримінальний процесуальний кодекс України від 13.04.2012 р. № 4651-VI (зі змін. та допов.). *Відомості Верховної Ради України (ВВР)*. 2013. № 9—10, 11—12, 13. Ст. 88. URL: https://zakon.rada.gov.ua/laws/show/4651-17 (date accessed: 17.12.2021).

18 Керівництво з вираження невизначеності у вимірюваннях. Харків, 2000 ; Тарасова В. В., Малиновський А. С., Рибак М. Ф. Метрологія, стандартизація і сертифікація : підручник. Київ, 2006. 264 с. URL: https://www.kspu.edu/FileDownload.ashx/Tarasova.pdf?id=cf16947b-5c04-42ae-b29f-c3ac6ad40f3e (date accessed: 17.12.2021) ; Кнорринг В. Г., Марамзина М. Г. Метрология, стандартизация, сертификация : учеб. пособ. Санкт-Петербург, 2006. 240 с.

19 Грибовский С. В. Оценка доходной недвижимости : учеб. пособ. для вузов. Санкт-Петербург, 2001. 334 с.

20 Поздняков Ю. В., Садовенко Ю. П. Кількісна оцінка точності визначення вартості об'єктів інтелектуальної власності. *Економіка та суспільство*. 2018. № 19. С. 216. DOI: 10.32782/2524-0072/2018-19-216 (date accessed: 17.12.2021).

In accordance with the current requirements of IVS, the valuation report should include as complete disclosure of the degree of uncertainty of the obtained result as possible. It can be expressed in several ways: verbal description of the appraiser's judgment on the accuracy of this result; justification of the degree of its rounding; submission of a numerical estimate of the error; indicating the confidence level and confidence interval, as well as in any other ways. The appraiser's judgment as a detailed verbal commentary on the degree of uncertainty is the easiest way, but it only shows a subjective qualitative characteristic. Qualitative verbal description is the least comprehensive way to express a judgment on the accuracy of valuation result, but it is better when it is than the total lack of comments in the report on the uncertainty and accuracy of a result. A verbal description provides only an approximate qualitative idea of accuracy, its indicators remain non-quantified, but this formally satisfies the requirements of IVS on description of the result uncertainty.

A fuller description of uncertainty is indication of confidence level and interval (when this data is supported by accuracy analysis calculations), which provides an objective quantitative characteristic. Rounding the calculated value is the most common method used by experienced appraisers to express the degree of uncertainty in a result. The form of result presentation (the degree of its rounding) includes an indication of achieved accuracy. The number of significant figures left after rounding shows the lines of the appraiser's responsibility for the valuation result. According to the rules, the rounding error must not exceed half a unit of the decimal point which is determined by the last non-zero significant figure remaining in the final rounded value of the result. Therefore, erroneous presentation of valuation result in a report without rounding and further use of the unrounded value constitute an interpretive error (accordingly, of an appraiser or a user), which consists in arbitrary expansion of the content of the appraiser's judgment in the sense of misunderstanding attained accuracy. When the appraiser hastily formulates the final result of implemented economic measurements in the same way as the calculated one (with segregated capability of up to UAH 1, and sometimes up to 1 kop.), it is usually mistakenly seen as an indication that the result is accurate to UAH 1 or 1. kop. That's why, such a non-rounded form of presenting the valuation result is not entirely accurate, but the current regulatory framework does not provide grounds for making claims to the appraiser, as IVS does not address the issue of uncertainty, accuracy and rounding of received results.

On the grounds of application of this format of valuation results presentation, sometimes quite fictitious indicators of losses are being formed by the simplest mathematical manipulations, the responsibility for which is unreasonably placed on an appraiser. In fact, this is the result of an elementary misunderstanding while interpretation of the valuation result, which accuracy can never reach the segrerated capability of the calculated result. Technically, it is several orders lower, usually remaining uncertain in neither a report nor an expert conclusion.

For cases where evaluative methodological approaches based on processing of multiple observations (comparative, income) are used in a studied report, objective quantitative characteristics of the degree of uncertainty of the obtained result can be determined ex post facto, in the course of forensic economic examination or review

of a report. The principal task of analyzing uncertainty and accuracy of a result is to determine values of confidence levels and intervals or estimates of result errors on the basis of market data used by an appraiser and their further processing in accordance with the applied mathematical and logical models. The comparison of these quantitative characteristics of uncertainty is a ground for objectively assessing the quality of economic measurements.

Due to the influence of multiple sources of uncertainty, the low level of accuracy of valuation results is the reason for their rather large variance in case of valuation of one valuation object at one valuation date. According to A. Kinh, a recognized worldwide authority in the valuation field, users of valuation reports understand intuitively that each valuation result is a personalized professional judgment that can not be absolutely accurate. The value of a valuation object as a measured parameter of probabilistic nature is characterized by a considerable degree of uncertainty, therefore accurate execution of valuation should include expression of professional opinion by an appraiser both on the result and the degree of uncertainty. If two appraisers receive the same valuation task and work independently, their results may be comparable, but they will never be the same. Such variability is more an advantage than a disadvantage of the valuation procedure [21].

While reviewing reports on valuation, it is expedient to analyze the degree of heterogeneity of the series of observational data of market information and their further processing, which quantitative characteristic is the variation coefficient. In mathematical statistics, there are certain criteria for determining the upper limit of the coefficient of series variation at which it is considered acceptable to use these data for accurate calculation of average estimates. If the coefficient of variation exceeds 33%, it demonstrates a critically high heterogeneity of data and impossibility to use them to determine the value of valuation [22] object. In economic measurements, requirements for homogeneity of series of researched indicators may be less sharp due to availability of a number of uncertainty sources and high volatility of market data. A similar statement about acceptable upper limit of the variation coefficient is outlined by M. L. Lapishko [23], who states that in order to solve tasks of economic analysis, the set is considered to be homogeneous, and evaluation of its average value is reliable if the variation coefficient does not exceed 33 %. A similar limitation is found in the valuation professional literature [24], which states that while valuation based on comparative approach, it can be suggested not to use a model which variation coefficient of series exceeds 33 %. Since in this case we can not assume that these parts are subordinated to the normal distribution law or the one close to it. If the calculated value of the coefficient is about 33 % smaller than the threshold value, then the average value of series is recognized as reliable, and the quality of results of determining the

21 Кинг А. Оценка справедливой стоимости для финансовой отчетности. Новые требования FASB / пер. с англ. Москва, 2011. С. 269.

22 Китаев Н. Н. Групповые экспертные оценки. Москва, 1975. 64 с. ; Соколов Г. А. Математическая статистика : учебник. Москва, 2007. 432 с.

23 Лапішко М. Л. Основи фінансово-статистичного аналізу економічних процесів. Львів, 1995. С. 72.

24 Грибовский С. В. Оценка стоимости недвижимости. Москва, 2009. С. 89.

average single indicator is quite high. Current IVS do not require to provide this indicator in a report, but it is advisable to check its value while forensic examination and review of reports. In particular, for a number of adjusted single indicators of comparison objects while valuation with the help of a comparative approach, since exceeding this indicator is often a sign of incorrect performance of valuation procedures of selecting comparison or adjustment objects. To validate the first one you can use certain techniques [25], for the second one: the following developments [26].

Conclusions

A principal issue while forensic economic examination of independent asset valuation of reports is the degree of uncertainty in received results. To obtain scientifically sound expert conclusions required to create a reliable evidence base, objective quantitative characteristics of the degree of uncertainty (e.g., values of confidence level and intervals or estimates of result errors, and / or indicators associated with them, including coefficient of data series variation) should be defined in a research. Verification of a report under study for compliance with the requirements of current IVS is a necessary but insufficient condition for developing a reasoned judgment on reliability of valuation result.

It should be taken into account that in certain cases, during review and forensic economic examination, it is possible to identify formal violations by the appraiser of the requirements of legal and regulatory framework, but at the same time to obtain a conditionally accurate valuation result. In contrast, there may be situations when there are no direct violations of such requirements in a report, but the valuation

25 Поздняков Ю. В., Лапішко М. Л. Критерій відбору та верифікації вихідних даних при оцінці нерухомості. *Magyar Tudományos Journal*. 2018. № 19. Pp. 5—10 ; Лапішко М. Л., Поздняков Ю. В. Інформаційний критерій максимальної частоти для відбору, верифікації та систематизації ринкової інформації. *Економіка та суспільство*. 2018. № 17. С. 114—119. DOI: 10.32782/2524-0072/2018-17-16 (date accessed: 17.12.2021) ; Поздняков Ю. В., Лапішко М. Л. Використання критерію максимальної вірогідності продажу при відборі даних ринкової інформації. *Економічні науки. Серія «Облік і фінанси»*. 2018. Вип. 15 (57). С. 172—182. DOI: 10.36910/6775-2707-8701-2018-15/57-21 (date accessed: 17.12.2021).

26 Поздняков Ю. В., Лапішко М. Л. Багаторазові непрямі економічні вимірювання як методологічна основа для встановлення невизначеності результату оцінювання вартості. *Приазовський економічний вісник*. 2019. № 5 (16). С. 415—421. DOI: 10.32840/2522-4263/2019-5-71 (date accessed: 17.12.2021) ; Їх же. Коригування на масштаб об'єкта оцінки з застосуванням нелінійного кореляційно-регресійного аналізу даних дослідження ринку. *Економічні студії*. 2019. № 4 (26). С. 141—148 ; Їх же. Абсолютная методическая погрешность метода дисконтированных денежных потоков в контексте информационного подхода. *Экономика и банки*. 2017. № 2. С. 23—31 ; Pozdnyakov Yu. V., Sadovenko Yu. P. (2020). Adjustment coefficients methodical error at economic measurements implementation with the use of comparative sales approach. The role of science in society sustainable development. *Monograph 34*. Katowice, 2020. Pp. 51—61. URL: https://www.wydawnictwo.wst.pl/uploads/files/20ad278a7f-9cbf86ed31d75bdc0730dd.pdf (date accessed: 17.12.2021) ; Поздняков Ю. В., Садовенко Ю. П. Зв'язок коефіцієнта гальмування під час коригування на масштаб зі ступенем невизначеності результату оцінки вартості активів. *Науковий вісник Міжнародного гуманітарного університету. Серія: Економіка і менеджмент*. 2019. Вип. 41. Ч. 1. С. 104—113. DOI: 10.32841/2413-2675/2019-41-14 (date accessed: 17.12.2021).

result can not be viewed as valid [27]. When comparing two (or more) valuation works of one valuation object at one valuation date, it is obligatory to study fulfillment of conditions of comparability in relation to these valuation works and to establish quantitative characteristics of the degree of uncertainty of their results. In another case, results of estimates should be considered as independent implementation of estimates of a random measured quantity lying within the range of its likely values. If there are two valuation works of the same valuation object at the same date, their results should be compared and analyzed given the quantitative indicators of uncertainty and accuracy of independent valuation results while each valuation. The methodology for identifying indicators of the degree of results uncertainty in conditions of several independent valuations is outlined in such works [28]. Research results can be formulated in conclusions of a forensic expert or specialist in accordance with Article 103 of the Civil Procedural Code and Article 71 of the Criminal Procedural Code of Ukraine.

As of today, neither the community of forensic experts nor appraisers nor appraisal users are ready for a conscious perception of the concept of uncertainty in the result of economic measurements performed by independent valuation methods. Although IVS have long promoted the concept of uncertainty, IVS form of presenting valuation results provided so far does not require any quantitative data on the degree of uncertainty in a report. The consequence of this is an extremely paradoxical situation, when results were obtained with an undetermined degree of uncertainty and unknown indicators of accuracy in the course of valuation. To date, IVS apply only the notion of valuation reliability, in no way specifying methods of its objective definition and description. Due to the lack of corresponding methodology developments, the level of reliability of valuation results is predominantly determined on the basis of subjective judgments of reviewers and forensic experts who usually focus only on identifying violations in regulatory requirements but do not have effective tools to objectively evaluate uncertainty.

As practice shows, valuation customers are for the most part unable to assess the valuation result expressed in the form of a confidence interval and a confidence level where the measured quantity of the value is within this interval. An average customer usually wants to get the valuation conclusion only in the form of a point measurement result: one value not burdened with additional data about the assessment of the degree of uncertainty of this result. The same applies to forensic experts and employees of governing and

27 Максимов С. Й. Висновок про достовірність оцінки майна не є гарантією достовірності результату звіту / Асоціація фахівців оцінки (офіційний сайт). 09.03.2016 р. URL: https://afo.com.ua/uk/news/2-general-assessment/1055-opinion-on-the-reliability-of-property-valuation-is-not-a-guarantee-of-reliability-results-report (date accessed: 17.12.2021).

28 Поздняков Ю. В., Скибінська З. М., Гринів Т. Т. Аналітичне обґрунтування методики розрахунку показників невизначеності результату незалежної оцінки вартості активів. *Вісник Одеського національного університету. Економіка.* 2020. Т. 25. Вип. 1 (80). С. 229—235. DOI: 10.32782/2304-0920/1-80-39 (date accessed: 17.12.2021) ; Поздняков Ю. В., Лапішко М. Л. Методика вибору кількості економічних вимірювань вартості при встановленні ступеня невизначеності результатів незалежної експертної оцінки / *Сучасні підходи до соціально-економічного, інформаційного та науково-технічного розвитку суб'єктів національного господарства* : монографія / за ред. Л. М. Савчук, Л. М. Бандоріної. Дніпро, 2020. С. 394—415.

supervisory authorities who focus primarily on the requirements of somewhat outdated current national regulatory framework for valuation, where the concept of uncertainty of its outcome is not even mentioned. Also, the notion of the uncertainty interval of this result is frequently misunderstood by valuation users, as the majority of them are unfamiliar with the basic principles of the measurement theory. Interval form of presenting economic measurement results is unacceptable in particular for accounting and bank valuation purposes (where any uncertainty of received value of assets is not permissible at all and the appraiser is obliged to tackle the almost impossible task of obtaining absolutely accurate value to an error lower than ± 1 kop.) .

Therefore, we deem it expedient to focus on modern approaches of IVS while forensic economic examinations that enable to objectively quantify the degree of uncertainty in valuation results. Submission of quantitative characteristics of report result uncertainty in an expert conclusion allows to specify statements for which the appraiser is responsible. If it was not included in a report, it means that the appraiser neglected the opportunity to limit the possibility of arbitrary interpretation of his professional judgment, which content he can prove mathematically. IVS do not require to present uncertainty characteristics in a report, but in this way the appraiser can separate his / her own evidential statements from the misleading ones that are provided only under specific conditions. It also excludes the possibility of arbitrary expanded interpretation of the appraiser's statements by other persons and eliminates the possibility of possible attempts to hold the appraiser responsible for expanded interpretation of his conclusions.

Identification of uncertainty characteristics in an expert conclusion will help to increase the degree of objectivity in forensic economic examination. After all, there are many cases when the court may make an unjust decision based on results of submitting expert research with incomplete or biased conclusions to the court. As a judge does not posses specific expertise, he cannot always thoroughly study and analyze a provided expert conclusion. It is what necessitates verifying compliance with an accuracy of the research algorithm and using scientifically sound research methods. This can be ensured by involving a specialist in the relevant field and reviewing expert conclusion or expert research of a specialist. The forensic examination conclusion is an independent procedural document received while forensic examination, it must include information synthesized within the competence of the forensic expert that was obtained using special scientific methods specifically in the course of research. The forensic report must meet the main criteria for evidence evaluation: relevance, admissibility, reliability and sufficiency [29]. If questions addressed to the forensic expert are developed as above, sufficiency condition of the expert conclusion as valid evidence should be deemed quantification of the value of an object and characteristics of uncertainty of results submitted in a studied report and obtained by a forensic expert.

Gradual implementation of current IVS requirements in the practice of forensic examination and review of valuation works, which require greater specification of the degree of uncertainty in obtained results, will ensure application of uniform unified methodological approaches in forensic expert practice, improve the quality and

29 Жеребко О. І. Висновок експерта: актуальні питання / *Судова експертиза: проблеми сьогодення та перспективи розвитку* : кол. моногр. Дрогобич, 2020. С. 48—54.

objectivity of expert researches, reduce the complexity of forensic examinations and enhance efficiency of their conduct [30]. It can be practically implemented by identification of quantitative indicators of quality in results of economic measurements with the development of a reasoned judgment by the forensic expert on the degree of uncertainty based on information and metrological evaluation paradigm [31].

Проблемні питання виконання судово-економічних експертиз звітів із незалежної експертної оцінки вартості активів

Юрій Поздняков, Ігор Братішко

Досліджено методичні засади проведення судово-економічних експертиз звітів з економічних вимірювань, які виконують методами незалежної оцінки вартості активів. Метою статті є висвітлення проблемних питань судово-економічних експертиз зі встановлення показників вартості активів, отриманих у результаті виконання економічних вимірювань методами незалежної експертної оцінки. Розглянуто проблемні питання обґрунтування методики кількісного встановлення ступеня невизначеності результатів оцінки на основі ймовірнісно-метрологічного підходу, що базується на застосуванні інтервальної форми представлення результату оцінки. Виконано порівняльний аналіз вимог національних і міжнародних стандартів оцінки до опису невизначеності результатів оцінки. Продемонстровано, що застосування порівняльного та прибуткового підходів дає змогу встановити показники невизначеності для заданих рівнів довірчої імовірності у вигляді чисельних значень меж довірчого інтервалу на підставі статистичної обробки множинних даних рядів ринкової інформації (зокрема, скоригованих одиничних показників пропозицій продажу або орендних ставок подібного майна). Представлено ознаки та сформульовано умови коректності виконання цих економічних вимірювань.

Ключові слова: *незалежна експертна оцінка; судово-економічна експертиза звіту; економічні вимірювання; похибка; точність; достовірність; невизначеність результату оцінки.*

Проблемные вопросы выполнения судебно-экономических экспертиз отчётов о независимой экспертной оценке стоимости активов

Юрий Поздняков, Игорь Братишко

Исследованы методические основы проведения судебно-экономических экспертиз отчётов об экономических измерениях, выполняемых методами независимой оценки стоимости активов. Целью статьи является освещение проблемных вопросов судебно-экономических экспертиз по установлению показателей стоимости активов, полученных в результате выполнения экономических измерений методами независимой экспертной оценки. Рассмотрены проблемные вопросы обоснования методики количественного установления степени неопределённости результатов оценки на основе вероятностно-метрологического подхода, основанного на применении интервальной формы представления результата оценки. Выполнен сравнительный анализ требо-

30 Бондар В. М. Визначення вартості машин та обладнання, що не представлені на внутрішньому ринку України. *Криминалистика и судебная экспертиза*. 2015. Вип. 60. С. 449—460. URL: https://nbuv.gov.ua/UJRN/krise_2015_60_47 (date accessed: 17.12.2021).

31 Pozdnyakov Yu., Lapishko M. The use of informative-metrological paradigm in independent expert valuation theory. *Monograph 27*. Information and Innovation Technologies in Economics and Administration. Katowice, 2019. Pp. 80—88.

ваний национальных и международных стандартов оценки, предъявляемых к описанию неопределённости результатов оценки. Продемонстрировано, что применение сравнительного и доходного подходов позволяет установить показатели неопределённости для заданных уровней доверительной вероятности в виде числовых значений границ доверительного интервала на основании статистической обработки множественных данных рядов рыночной информации (в частности, скорректированных единичных показателей предложений продажи или ставок аренды подобного имущества). Представлены признаки и сформулированы условия корректности выполнения этих экономических измерений.

Ключевые слова: *независимая экспертная оценка; судебно-экономическая экспертиза отчёта; экономические измерения; погрешность; точность; достоверность; неопределённость результата оценки.*

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The authors declares that he has no conflict of interest.

References

Baldzhy, M. D. (2015). *Ekonomichnyi ryzyk ta metody yoho vymiriuvannia* [Economic risk and methods of its measurement] : navch. posib. Kharkiv [in Ukrainian].

Bondar, V. M. (2015). Vyznachennia vartosti mashyn ta obladnannia, shcho ne predstavleni na vnutrishnomu rynku Ukrainy [Valuation of machines and equipment, which are not represented in the Ukrainian domestic market]. *Krymynalystyka y sudebnaia ekspertyza.* Vyp. 60. URL: https://nbuv.gov.ua/UJRN/krise_2015_60_47 [in Ukrainian].

Chalyi, V. P. (2006). Neopredelennost i pogreshnost, ikh skhodstvo, razlichie i upotreblenie v raznykh metrologicheskikh protsedurakh [Uncertainty and error, their similarity, difference and use in different metrological procedures]. *Systemy obrobky informatsii.* Vyp. 7 (56). URL: https://nbuv.gov.ua/UJRN/soi_2006_7_27 [in Russian].

Gribovskii, S. V. (2001). *Otsenka dokhodnoi nedvizhimosti* [Valuation of profitable real estate] : ucheb. posob. dlia vuzov. Sankt-Peterburg [in Russian].

Gribovskii, S. V. (2009). *Otsenka stoimosti nedvizhimosti* [Real estate valuation]. Moskva [in Russian].

Harazha, O. P. (2016). Standartyzatsiia otsinky maina u sviti [Standardization of property valuation in the world]. *Naukovyi visnyk Mizhnarodnoho humanitarnoho universytetu. Seriia «Ekonomika i menedzhment»*. Vyp. 17. URL: https://nbuv.gov.ua/UJRN/Nvmgu_eim_2016_17_10 [in Ukrainian].

Horlachuk, O. A. (2021). Teoretyko-metodolohichni zasady sudovoi ekonomichnoi ekspertyzy [Theoretical and methodological foundations of forensic economics]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 23. DOI: 10.32353/khrife.1.2021.23 [in Ukrainian].

Kerivnytstvo z vyrazhennia nevyznachenosti u vymiriuvanniakh [Guide to expressing uncertainty in measurements] (2000). Kharkiv [in Ukrainian].

King, A. (2011). *Otsenka spravedlivoi stoimosti dlia finansovoi otchetnosti. Novye trebovaniia*

FASB [Fair value estimation for financial reporting. FASB New requirements] / per. s angl. Moskva [in Russian].

Kitaev, N. N. (1975). *Gruppovye ehkspertnye otsenki* [Group expert valuations] : uchebnik. Moskva [in Russian].

Knorring, V. G., Maramzina, M. G. (2006). *Metrologiia, standartizatsiia, sertifikatsiia* [Metrology, standardization and certification] : ucheb. posob. Sankt-Peterburg [in Russian].

Lapishko, M. L. (1995). *Osnovy finansovo-statystychnoho analizu ekonomichnykh protsesiv* [Fundamentals of financial and statistical analysis of economic processes]. Lviv [in Ukrainian].

Lapishko, M. L., Pozdniakov, Yu. V. (2018). Informatsiinyi kryterii maksymalnoi chastoty dlia vidboru, veryfikatsii ta systematyzatsii rynkovoi informatsii [Maximal frequency information criterion for selection, verification and systematization of the market information data]. *Ekonomika ta suspilstvo*. № 17. DOI: 10.32782/2524-0072/2018-17-16 [in Ukrainian].

Lukianova, V. V. (2017). Dualizm nevyznachenosti ta ryzyku v ekonomichnykh yavyshchakh [Dualism of vagueness and risk is in the economic phenomena]. *Visnyk Khmelnytskoho natsionalnoho universytetu.* № 2 (2). URL: https://nbuv.gov.ua/UJRN/Vchnu_ekon_2017_2%282%29__46 [in Ukrainian].

Lytvynenko, T. M. (2009). Nevyznachenist rynkovoho seredovyshcha ta shliakhy yii lokalizatsii [Uncertainty of the market environment and ways of its localization.]. *Teoretychni ta prykladni pytannia ekonomiky* : zb. nauk. pr. KNU im. T. H. Shevchenka. T. 19. URL: https://tppe.econom.univ.kiev.ua/data/2009_19/zb19_07.pdf [in Ukrainian].

Maksymov, S. Y. (2016). *Vysnovok pro dostovirnist otsinky maina ne ye harantiieiu dostovirnosti rezultatu zvitu* [The conclusion on reliability of the property valuation is not a guarantee of report result reliability] / Asotsiatsiia fakhivtsiv otsinky (ofitsiinyi sait). URL: https://afo.com.ua/uk/news/2-general-assessment/1055-opinion-on-the-reliability-of-property-valuation-is-not-a-guarantee-of-reliability-results-report [in Ukrainian].

Pozdniakov, Iu. V., Lapishko, M. L. (2017). Absoliutnaia metodicheskaia pogreshnost metoda diskontirovannykh denezhnykh potokov v kontekste informatsionnogo podkhoda [Maximal sale probability criterion using for primary market information data selection]. *Ehkonomika i banki*. № 2 [in Russian].

Pozdniakov, Yu. V. (2021). *Nevyznachenist rezultatu nezalezhnoi ekspertnoi otsinky* [Uncertainty of the result of independent expert valuation] : monohrafiia. LAP Lambert Academic Publishing [in Ukrainian].

Pozdniakov, Yu. V., Lapishko, M. L. (2018). Kryterii vidboru ta veryfikatsii vykhidnykh danykh pry otsintsi nerukhomosti [Criteria for selection and verification of source data in real estate appraisal]. *Magyar Tudományos Journal*. № 19 [in Ukrainian].

Pozdniakov, Yu. V., Lapishko, M. L. (2018). Vykorystannia kryteriiu maksymalnoi virohidnosti prodazhu pry vidbori danykh rynkovoi informatsii [Maximal sale probability criterion using for primary market information data selection]. *Ekonomichni nauky. Seriia «Oblik i finansy»*. Vyp. 15 (57). DOI: 10.36910/6775-2707-8701-2018-15/57-21 [in Ukrainian].

Pozdniakov, Yu. V., Lapishko, M. L. (2019). Bahatorazovi nepriami ekonomichni vymiriuvannia yak metodolohichna osnova dlia vstanovlennia nevyznachenosti rezultatu otsiniuvannia vartosti [Multiple indirect economic measurements as methodological base for valuation results uncertainty degree determination]. *Pryazovskyi ekonomichnyi visnyk*. № 5 (16). DOI: 10.32840/2522-4263/2019-5-71 [in Ukrainian].

Pozdniakov, Yu. V., Lapishko, M. L. (2019). Koryhuvannia na masshtab obiekta otsinky z zastosuvanniam neliniinoho koreliatsiino-rehresiinoho analizu danykh doslidzhennia rynku [Valuation object size adjustment with the use of market data research nonlinear cross-correlation regressive analysis]. *Ekonomichni studii*. № 4 (26) [in Ukrainian].

Pozdniakov, Yu. V., Lapishko, M. L. (2020). Metodyka vyboru kilkosti ekonomichnykh vymiriuvan vartosti pry vstanovlenni stupenia nevyznachenosti rezultativ nezalezhnoi ekspertnoi otsinky [The method of choosing the number of economic measurements of value while establishing the degree of uncertainty of results independent expert valuation] / *Suchasni pidkhody do sotsialno-ekonomichnoho, informatsiinoho ta naukovo-tekhnichnoho rozvytku sub'iektiv natsionalnoho hospodarstva* : monohrafiia / za red. L. M. Savchuk, L. M. Bandorinoi. Dnipro [in Ukrainian].

Pozdniakov, Yu. V., Sadovenko, Yu. P. (2018). Kilkisna otsinka tochnosti vyznachennia vartosti obiektiv intelektualnoi vlasnosti [Quantitative estimation of intellectual property objects evaluation accuracy]. *Ekonomika ta suspilstvo*. № 19. DOI: 10.32782/2524-0072/2018-19-216 [in Ukrainian].

Pozdniakov, Yu. V., Sadovenko, Yu. P. (2019). Zviazok koefitsiienta halmuvannia pid chas koryhuvannia na masshtab zi stupenem nevyznachenosti rezultatu otsinky vartosti aktyviv [Scale factor relationship with assets valuation result uncertainty degree at object size adjustment]. *Naukovyi visnyk Mizhnarodnoho humanitarnoho universytetu. Seriia: Ekonomika i menedzhment.* Vyp. 41. Ch. 1. DOI: 10.32841/2413-2675/2019-41-14 [in Ukrainian].

Pozdniakov, Yu. V., Skybinska, Z. M., Hryniv, T. T. (2020). Analitychne obgruntuvannia metodyky rozrakhunku pokaznykiv nevyznachenosti rezultatu nezalezhnoi otsinky vartosti aktyviv [Mathematical principles analytical ground of assets independent valuation results uncertainty degree indexes calculation methodology]. *Visnyk Odeskoho natsionalnoho universytetu. Ekonomika*. T. 25. Vyp. 1 (80). DOI: 10.32782/2304-0920/1-80-39 [in Ukrainian].

Pozdnyakov, Yu. V., Sadovenko, Yu. P. (2020). Adjustment coefficients methodical error at economic measurements implementation with the use of comparative sales approach. The role of science in society sustainable development. *Monograph 34*. Katowice. URL: https://www.wydawnictwo.wst.pl/uploads/files/20ad278a7f9cbf86ed31d75bdc0730dd.pdf [in Ukrainian].

Pozdnyakov, Yu., Lapishko, M. (2019). The use of informative-metrological paradigm in independent expert valuation theory. *Monograph 27*. Information and Innovation Technologies in Economics and Administration. Katowice [in Ukrainian].

Ripenko, A. *Pravovi zasady provedennia sudovoi ekspertyzy* [Legal principles of conducting forensic examination] / Liha. Blohy. URL: https://blog.liga.net/user/aripenko/article/25443 [in Ukrainian].

Simakova-Yefremian, E. B. (2020). Do pytannia pro vvedennia u kryminalne protsesualne zakonodavstvo poniattia «vysnovok spetsialista» [On the issue of introduction of the concept of specialist's conclusion into criminal procedural legislation]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 20. DOI: 10.32353/khrife.2.2019.07 [in Ukrainian].

Sokolov, G. A. (2007). *Matematicheskaia statistika* [Math Statistics] : uchebnik. Moskva [in Russian].

Tarasova, V. V., Malynovskyi, A. S., Rybak, M. F. (2006). *Metrolohiia, standartyzatsiia i sertyfikatsiia* [Metrology, standardization and certification] : pidruchnyk. Kyiv. URL: https://www.kspu.edu/FileDownload.ashx/Tarasova.pdf?id=cf16947b-5c04-42ae-b29f-c3ac6ad40f3e [in Ukrainian].

Vasylenko, I. F. (2016). Vplyv kontseptsii nevyznachenosti vymiriuvan na metrolohichnu diialnist [Influence of the concept of measurement uncertainty on metrological activity]. *Naukovi zapysky*. Vyp. 19. URL: https://dspace.kntu.kr.ua/jspui/bitstream/123456789/4329/1/5__19_2016-59-69.pdf [in Ukrainian].

Vasyliev, V. M. (2020). Sudova ekspertyza u tsyvilnomu ta hospodarskomu provadzhenni yak okrema forma zastosuvannia spetsialnykh znan [Forensic science in civil and commercial proceedings as a separate form of specific expertise application]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 21. DOI: 10.32353/khrife.1.2020_08 [in Ukrainian].

Vitlinskyi, V. V., Nakonechnyi, S. I., Sharapov, O. D. (1996). *Ekonomichnyi ryzyk i metody yoho vymiriuvannia* [Economic risk and methods of its measurement] : pidruchnyk. Kyiv [in Ukrainian].

Vitlinskyi, V. V., Velykoivanenko, H. I. (2004). *Ryzykolohiia v ekonomitsi ta pidpryiemnytstvi* [Riskology in economics and business] : monohrafiia. Kyiv, 2004. [in Ukrainian].

Vvedenie k «Rukovodstvu po vyrazheniiu neopredelennosti izmereniia» i soputstvuiushchim dokumentam. Otsenivanie dannykh izmerenii [Introduction to "The guidelines for the expression of measurement uncertainty" and relevant documents. Estimation of measurement data] (2011) / per. s angl. ; pod nauch. red. prof. V. A. Slaeva, A. G. Chunovkinoi. Sankt-Peterburg [in Russian].

Zhadan, T. A., Zhadan, Yu. V. (2018). Suchasni naukovi pidkhody do rozuminnia ekonomichnoho zmistu poniattia «ryzyk» [Modern scientific approaches to understanding economic content concept "risk"]. *Prychornomorski ekonomichni studii.* Vyp. 33. URL: https://nbuv.gov.ua/UJRN/bses_2018_33_17 [in Ukrainian].

Zherebko, O. I. (2020). Vysnovok eksperta: aktualni pytannia [Expert's statement: actual aspects] / *Sudova ekspertyza: problemy sohodennia ta perspektyvy rozvytku* : kol. monohr. Drohobych [in Ukrainian].

Pozdnyakov, Yu., Bratishko, I. (2022). Challenging issues of performing forensic economic examinations of reports on independent expert valuation of asset value. *Theory and Practice of Forensic Science and Criminalistics.* Issue 1 (26). P. 108—124. DOI: 10.32353/khrife.1.2022.07.

Authenticate images based on their semantic segmentation in deep learning neural networks with their pre-processing with use of filtering methods

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In modern domestic and international pre-trial practice and legal proceedings, physical evidence used in the form of electronic documents or their digital images. The issue of authenticating such images is hampered by possibilities of using artificial intelligence based editors to fake images making it impossible or significantly complicate the search for changed areas by forensic experts. Research issue considered by the authors is the authenticity assessment of digital images based on the use of their pre-processing (filtering) methods and artificial intelligence technologies for further analysis and determination of edited areas.

This research paper purpose is to develop information technology for finding editing zones based on a combination of imaging techniques and neural network models for use in image authenticity research.

Research paper novelty is to develop a technology to combine several methods of pre-processing images (in particular, ELA and PCA) to create an input stream of a deep learning neural network and to assess effectiveness of identifying editing zones created by the digital painting editor (Inpainting).

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Efficiency of 10 editing zone detectors using combination of ELA and PCA methods with different models of neural networks for recognizing editing zones has been developed and investigated. The best results (probability of recognition 0.916) within the used computing resources were obtained by detector based on the EfficientNet model.

IT Effectiveness and related software for assessing authenticity of images based on a combination of image pre-processing methods and models of artificial neural networks in semantic classification and segmentation mode has been developed and evaluated.

Keywords: *image authenticity; artificial intelligence; neural networks; ELA; PCA; Inpainting.*

Research Problem Formulation

Scientific issue considered in this research paper is the authenticity assessment of digital images based on the use of their pre-filtering methods and artificial intelligence technologies. Currently, physical evidence is used in the form of electronic documents or their images, photographs, videos, scanned copies that have a digital formation nature.

At the same time, scientific and technological progress in the field of photography and video recording, methods and means of software editing of digital images creates ample opportunities for manipulating content of digital images and actualizes their authentication issue. The issue is further hampered by the use of artificial intelligence methods for editing images to prevent or complicate the search for altered areas.

Analysis of Essential Researches and Publications

Research of photographic images is devoted to fundamental research papers of D. Ya. Myrskyi, P. F. Sylkyn, Ye. M. Dmytriiev, etc. The process of researching digital photos is much more complicated because they have a different creation nature. Researches on digital photographs in order to identify signs of installation was considered by A. O. Safonov, V. H. Kalenskyi, Ye. M. Dmytriiev, S. M. Bobrytskyi, S. V. Chornyi, et al. Best practices of domestic and foreign researchers are devoted to research on additional data (file metadata) describing conditions and methods of file obtaining. This is devoted to research papers of R. Blythe, J. Fridrich, A. A. Kobozev, N. Krawetz, Ye. M. Dmytriiev, G. K. Wallace [1].

1 E.g., Мирский Д. Я. Судебная фототехническая экспертиза : метод. пособ. для экспертов. Москва, 1982. 167 с. ; Силкин П. Ф. Судебно-исследовательская фотография : учебник. Волгоград, 1979. 335 с. ; Дмитриев Е. Н. Судебная экспертиза фотографических изображений: современное состояние и возможности решения экспертных задач. *Судебная экспертиза*. 2009. № 3. С. 73—79 ; Сафонов А. А., Колотушкин С. М., Кочубей А. В. Компьютерные технологии в криминалистической фотографии: теоретические и прикладные вопросы : учеб. пособ. Волгоград, 2005 ; Каленський В. Г. Дослідження цифрових фотознімків з метою виявлення ознак монтажу. *Судова експертиза. Сучасний стан та перспективи розвитку* : мат-ли міжнар. наук.-практ. конф. Київ, 2010. С. 191—192 ; Бобрицкий С. М., Черный С. В. Методические аспекты комплексного исследования с целью выявления признаков монтажа в цифровой фотографии. *Теорія та практика судової*

Currently, the closest to this research area is *Methods of research of digital photographic images and technical means of their manufacture* [2] and *Methods of research of signs of digital image editing based on noise entropy analysis*[3]. For supporting the latter, the authors have developed appropriate software [4] for comparative research with known and modified methods of image quality assessment (33 methods of local focusing quality, 17 are noise characteristics, 15 are analysis by Discrete Cosine Transform (DCT), 14 are image entropy analysis).

These methods correspond to tasks of forensic examination of digital images. However, it should be noted that use of various methods of these methods (Error Level Analysis (ELA), Principal Component Analysis (PCA)) requires considerable expert experience and research time.

Performed researches is a significant contribution to development of theoretical foundations for specific expertise use in forensic science. At the same time, the analysis of possibilities of research on authenticity of digital images based on the use of their pre-filtering methods and artificial intelligence technologies is an issue that still requires in-depth scientific research. Given the above, further improvements, in our opinion, require research on use of artificial intelligence technologies in combination with the above methods of pre-processing images to recognize altered areas of digital images.

Article purpose

This article purpose is IT development for finding editing zones based on models of neural networks while research on authenticity of images. In our opinion, the main attention of scientists should be paid to development of methods and specialized software for advanced image analysis using modern methods of image processing.

Main Content Presentation

One of the most important tasks of modern forensic research on digital photographs and videos is to detect the signs of their photomontage or editing.

Given the relative ease of creating, modifying, and distributing digital records, investigators or courts have a relevant question about their authenticity. The *authentic* term in relation to phonograms in the sense of *true*, *reliable* is now widely used

експертизи і криміналістики. 2010. Вип. 10. С. 633—639 ; Blythe P., Fridrich J. Secure digital camera. *Digital Forensic Research Workshop* (Baltimore, USA, 11—13.08.2004). P. 12 ; Кобозева А. А. Использование особенностей возмущений сингулярных чисел матрицы цифрового изображения для обнаружения его фальсификации. *Искусственный интеллект*. 2008. № 1. С. 145—153; Krawetz N. A Picture's Worth... Digital Image Analysis and Forensics. 2007. URL: https://www.hackerfactor.com/papers/bh-usa-07-krawetz-wp.pdf (date accessed: 17.01.2022) ; Дмитриев Е. Н. Метаданные как средство индивидуализации цифровых изображений в судебной фотографии. *Теория и практика судебной экспертизы в современных условиях* : мат-лы междунар. науч.-практ. конф. Москва, 2007. С. 531—534 ; Wallace G. K. The JPEG Still Picture Compression Standard. IEEE Transactions on Consumer Electronics. 1991.

2 Методика досліджень цифрових фотозображень та технічних засобів їх виготовлення. Реєстр методик проведення судових експертиз. URL: https://rmpse.minjust.gov.ua/page/41 (date accessed: 17.01.2022).

3 Методика дослідження ознак монтажу цифрових зображень на основі аналізу ентропії шумів. Реєстр методик проведення судових експертиз. URL: https://rmpse.minjust.gov.ua/page/43 (date accessed: 17.01.2022).

4 IFD TEC. URL: https://5.189.182.106 (date accessed: 17.01.2022).

in English law, although it was originally adopted in theory of forensic research by Polish forensic scientists [5], later it was also used by American forensic experts [6].

Current progress of technical means of photo, video, recording and telecommunication technologies expands as possibilities of traditional data capture tools as emergence of new ways to obtain records (mobile, network, specialized) with new data formats. This requires constant updating of specific expertise of experts in the field of research on digital images, video and sound recordings. This issue is of particular relevance due to the fact that criminals are improving the ways of committing crimes, increasingly masking their traces, using modern achievements of science and technology. Therefore, without use of the latest means, it is often impossible or extremely difficult to document the actions of criminals and bring them to criminal responsibility.

Traditionally, the forensic photography subject were material data (positives, negatives, various technical means for their manufacture), that were procedurally enshrined in the case files. However, current methods of studying photographic images obtained using analog technology are ineffective for research on digital photos. The main modern objects of these researches are:

- digital photographs (photographs obtained as a result of photographing objects at a specific point in time and presented on media in the form of computer files of graphic formats);
- digital video and sound recordings recorded on physical media or directly on recording devices; individual frames or groups of frames from digital video recordings of objects at specific time intervals, represented on media in the form of computer files of graphic formats;
- photographing technical means (digital cameras);
- video recording technical means (digital video cameras, video recorders, etc.).

Comparative research objects include:

- digital photographs (photographs obtained as a result of photographing objects at a specific point in time and presented on media in the form of computer files of graphic formats);
- digital photo images presented on media in the form of computer files of graphic formats, methods and conditions for obtaining are determined.

Digital graphic file as research object differs significantly from traditional photograph, since in addition to information about the image/drawing itself (format, width, height, number of pixels per inch, number of bits per pixel, color model, and other characteristics and comments), such a file also contains information about its metadata (name, size, type, creation dates and last changes, etc.). The most interesting of them are EXIF data [7], that in research papers of domestic and foreign scientists are mentioned as

5 Гургуль К. Из процессуальной и криминалистической проблематики магнитофонной записи. *Сборник переводов*. № 213. Москва, 1973. С. 61—81 ; Проблемы криминалистики. Варшава, 1971. № 90. С. 159—183.

6 Hollien H. The Acoustics of Crime: The New Science of Forensic Phonetics. Florida, 1994.

7 EXIF (Exchangeable Image File Format) is a standard that allows to add additional information (metadata) to images and audio files, comments on this file, and describes conditions and methods of its obtaining, authorship, etc.

additional data formed as a result of built-in software operation of modern digital photo or video recording device. They allow you to emphasize individual features of the digital camera or applications that saved the latest graphic revision of the file using:

- digital camera manufacturer name and its model;
- interoperability analysis of technical capabilities of a particular digital camera with those recorded in EXIF data;
- name and version of built-in digital camera application;
- highlighting the signature with recording of data about the application or device that stored the latest graphic file revision.

Digital image or video editing programs often change file metadata fields, the order of fragments and the information on adding new ones and/or completely their deleting. A significant number of applications editing digital records leave their records (tags) in the file service part and information about the previous application can be deleted.

Graphic file can be considered as an object, which research is associated with assessment of the change in the noise background of digital matrix of the video or photographic recording device.

Researches on file structure (in particular, header metadata, recorded content, metadata multiplexed with recorded content, as well as possible data at the end of digital recording) belong to observational analysis, they should be compared with sample records made from recording devices provided for research or other test records. If the source recording device is unavailable or cannot be used, forensic expert can use the same device model.

The most challenging tasks are expert tasks related to technical research on digital images and video recordings. Currently, automation of researches on authenticity of digital images (individual frames from video recordings) is an urgent scientific task. Many separate methods for examining authenticity of images have been developed that solve issues only in certain conditions. There is a need for forensic expert practice in automating generalization of results of such individual researches on one object to increase reliability of the decision made by forensic expert.

The method of studying authenticity of digital images proposed in this paper is based on artificial intelligence principles, it is based on automatic generalization of individual research results of authenticity of digital images obtained by various methods of their preliminary digital analysis (filtering) and on the use of convolutive neural networks of deep learning to find editing zones. As an IT in image authentication research, this is a combination of image preprocessing methods and neural network models.

Urgency of conducting research in this area is due to the need to provide forensic expert practice with modern domestic methodological developments for assessing authenticity of images. Currently, we have accumulated practical experience of expert work of the specialists of National Scientific Center «Hon. Prof. M. S. Bokarius Forensic Science Institute» on analysis of images during performance of various forensic expert tasks within research on video, sound recordings and digital images that should be supplemented with technology of automatic generalization of results, systematize world experience and develop a comprehensive approach to solve relevant expert tasks.

An important stage while software development using artificial neural network models is database preparation of edited images necessary for their training and testing. Therefore, it is necessary select the appropriate editor and use it to create a set of edited images. We consider the editor of NVIDIA Inpainting to be the most effective in terms of quality of editing [8], that is why

8 Inpainting. URL: https://en.wikipedia.org/wiki/Inpainting (date accessed: 17.01.2022) ; Image Inpainting. URL: https://www.nvidia.com/research/inpainting/ (date accessed: 17.01.2022).

we will consider methodology of data preparation on its example. It is necessary to select or create a set of original images in advance (in our study, such a set was created by photographing various scenes with the Xiaomi Redmi Note 7 Pro smartphone, the size of master copy is 3000 × 4000 pixels).

Each of images is transformed using editor working window according to the principle shown in Fig. 1 into an edited image with imitation of deleted areas (Fig. 1, c) and into a mask of deleted areas (Fig. 1, d). After completing this step, the masks of edited zones and edited images are saved through the clipboard and the local Paint editor as separate images with the same names but in different folders. The resulting set of edited images and masks of deleted areas are subsequently used to train classifiers of the neural network model.

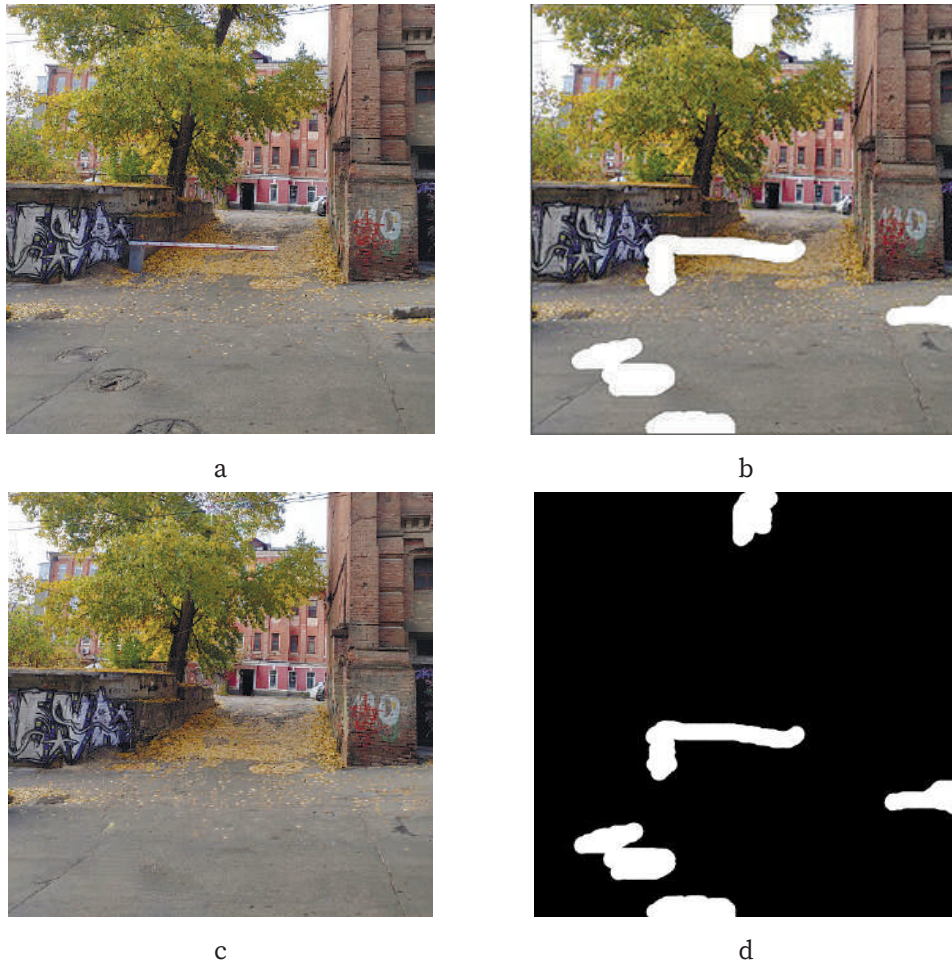

Fig. 1. Editing results: *a*) is image master copy, *b*) is master copy with the mask of deleted fragments, *c*) is image automatically simulated by editor, *d*) is mask of deleted zones)

Let us consider research prerequisites and criteria for assessing recognition quality. The research was performed under the following conditions:

- editing images using NVIDIA digital painting technology;
- image preprocessing by ELA and PCA methods.

Semantic classification quality and segmentation of editing zones was assessed according to the following criteria:

- portion of correctly classified edited pixels relative to the actual number of edited pixels (PM);
- relative error in defining the edit mask (D);
- portion of erroneously classified pixels outside valid editing zones (NM);
- visual assessment by forensic expert of the fact of editing according to the results of semantic segmentation (V).

Basic ratios (in terms of Python code) for the first criterion:

PM=np.sum(c1)/np.sum(im1N),c1=np.multiply(im4N,im1N);

where: im1N is real editing mask;

im4N is evaluated editing mask;

np.multiply() is array element-by-element multiplication operator;

np.sum() is an array summation operator.

Basic ratios (in terms of Python code) for the first criterion:

D=np.sum(np.abs(c2))/np.sum(im1N), c2=np.subtract(im4N,im1N);

np.multiply() is array element-by-element multiplication operator;

np.abs() is an operator for calculating the absolute values of array elements.

Basic ratios (in terms of Python code) for the first criterion:

i=np.multiply(im1N-1,-1);

c3=np.multiply(im4N,im1neg);

NM=np.sum(c3)/np.sum(i).

The main ratios for the fourth criterion are:

- V = 1, editing area is visually determined based on the segmentation results;
- V = 0, editing zone is not visually defined based on segmentation results.

The expert's visual assessment of the fact of editing based on results of semantic segmentation V is used to calculate the probability of recognition for each of the experimental models of neural networks.

Based on a preliminary assessment of software performance in conditions of available computing capabilities of the Kaggle public cloud resource for training models of neural networks, the authors chose the models of the following types for research: FPN-EfficientNetB4 [9], FPN-EfficientNetB4-96 [11], LinkNet-EfficientNetB3 [11], Unet-EfficientNetB4 [11], Keras Unet Collection Attunet [10], Keras Unet Collection Vnet [11], LinkNet DenseNet-201 [12], DeepLabV3Plus-MobileNetV1 [13], BiSegNet-MobileNetV1, BiSegNet-Xception [14].

9 TF Semantic Segmentation. URL: https://pypi.org/project/tf-semantic-segmentation/ (date accessed: 17.01.2022).

10 Keras-unet-collection 0.1.13. URL: https://pypi.org/project/keras-unet-collection/ (date accessed: 17.01.2022).

11 Segmentation-models. URL: https://pypi.org/project/segmentation-models (date accessed: 23.03.2021).

12 Ibid. URL: https://github.com/qubvel/segmentation_models (date accessed: 17.01.2022).

13 Amazing-Semantic-Segmentation. URL: https://github.com/luyanger1799/Amazing-Semantic-Segmentation (date accessed: 17.01.2022) ; Ibid. URL: https://pypi.org/project/semantic-segmentation (date accessed: 25.03.2021).

14 Chollet F. Xception: Deep Learning with Depthwise Separable Convolutions. URL: https://arxiv.org/pdf/1610.02357.pdf (date accessed: 22.03.2021).

Let us consider the summarized research results. Analysis of the results of testing of selected models of artificial neural networks in certain conditions indicates the presence of scattering of quality indicators on the used set of test images created by the Inpainting editor. Therefore, it is advisable to consider the averages for each network and the test image set at all. The average values of PM, D, NM, V for testing conditions are presented in Table 1, for selective ranges (close to the highest values of the probability of recognition) in Fig. 2—4.

Table 1

Averages of studied networks

Network Model Name	PM	D	NM	V
FPN-EfficientNetB4-16	0.446	0.718567	0.01067	0.75
FPN-EfficientNetB4-96	0.446	0.718567	0.01067	0.791667
LinkNet-EfficientNetB3	0.532237	0.824179	0.022165	0.833333
Unet-EfficientNetB4	0.522778	0.62255	0.011115	0.916667
Keras Unet Collection Attunet	0.044962	0.991533	0.002467	0.458333
Keras Unet Collection Vnet	0.01882	1.063992	0.0044	0.25
LinkNet-DenseNet-201	0.247155	1.012773	0.018333	0.791667
DeepLabV3Plus-MobileNetV1	-0.49301	11, 97283	-0.86514	0.25
BiSegNet-MobileNetV1	-0.31014	1.928322	-0.01952	0.333333
BiSegNet-Xception	-0.96842	15.61361	-1.05829	0.458333

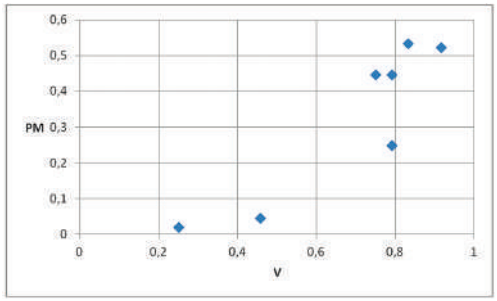

Fig. 2. Dependence of the average PM on the average probability of recognition V

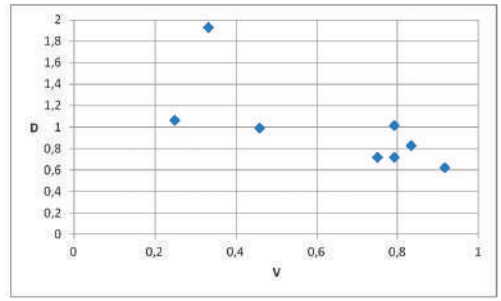

Fig. 3. Dependence of the average D on the average probability of recognition V

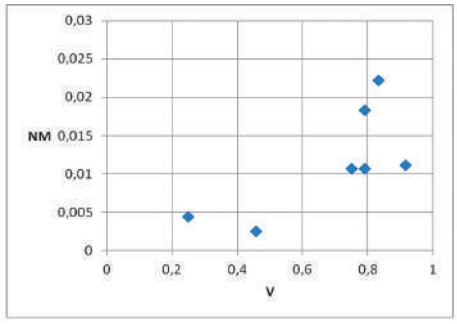

Fig. 4. Dependence of the average NM on the average probability of recognition V

Analysis of the data shown in Fig. 2—4 makes possible to distinguish the relative absolute total error of detection of the editing zone D as the most accurate and unambiguous indicator of the quality of the semantic classifier. It is possible to use playback accuracy of the PM editing zones. The least unambiguous relative to the average probability of recognition was the NM indicator.

Authenticity evaluation example of zones in the edited image (a deleted image of a concrete wall with pictures on the bank of the canal and 2 windows on the wall of the building) for the best D networks is shown in Fig. 5—6.

Thus, the best of studied classifiers of semantic type with data pre-processing according to the ELA and PCA algorithms within selected models of neural networks was the model of the artificial neural network of the Unet type with the EfficientNetB4 feature classifier.

a b

Fig. 5. Test image: *a*) is original; *b*) is edited image

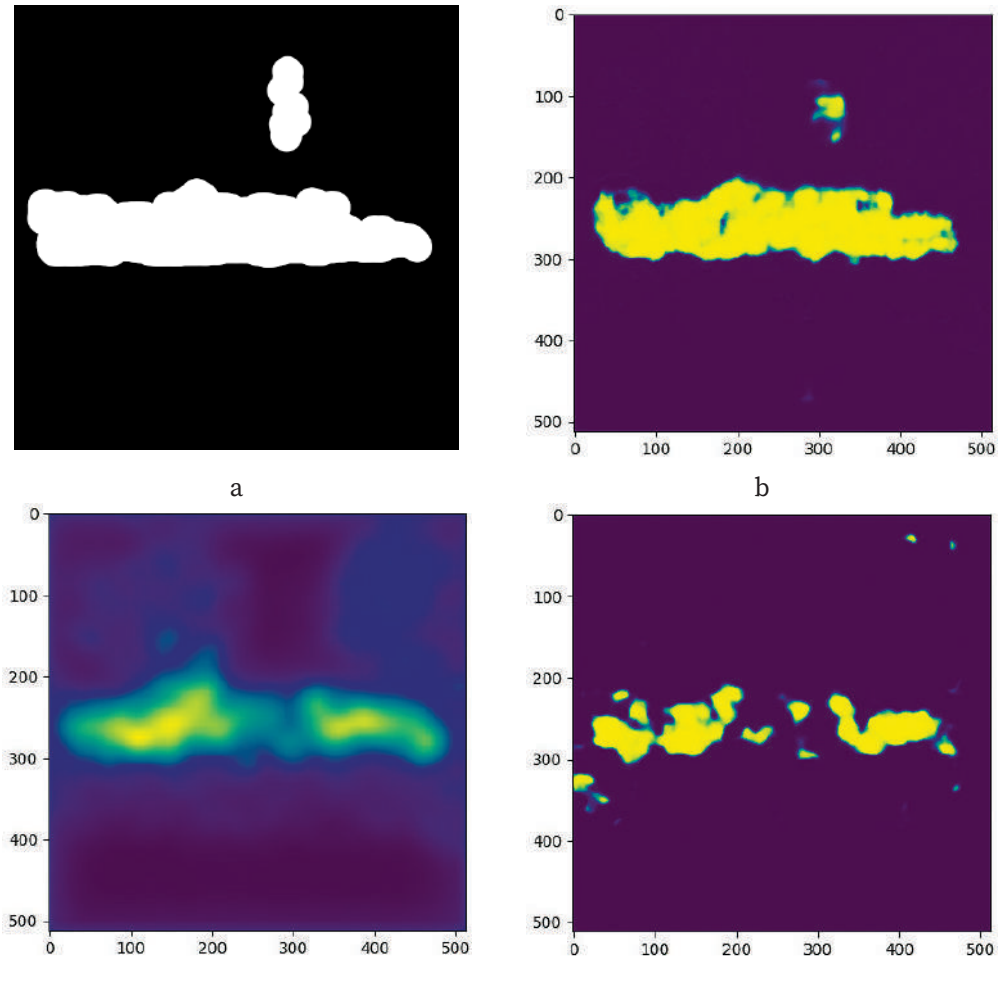

Fig. 6. Results of semantic segmentation of the edited test image:
a) is real editing zone; *b)* is Unet-EfficientNetB4 network;
c) is BiSegNet-Xception network; *d)* is AttUnet network

Conclusions

This research paper presents the research results of effectiveness of combining methods of pre-processing images and neural networks of deep learning to detect signs of editing, developed information technology and software for assessing the authenticity of images based on a combination of methods of pre-processing images and models of artificial neural networks in the mode of semantic classification and segmentation.

The achieved probability of recognition of edited areas of the Unet-type network with the EfficientNetB4 feature classifier

and pre-processing of images by ELA and PCA methods was 0.91. 4 performance indicators of the semantic classifier are studied and it is determined that the relative absolute total error of detection of the editing zone D is the most accurate and unambiguous numerical work quality indicator.

Автентифікація зображень на основі їх семантичної сегментації у нейронних мережах глибокого навчання з їх попереднім обробленням за методами фільтрації

Сергій Чорний, Ольга Брендель, Давіт Гратіашвілі

У сучасній вітчизняній та міжнародній досудовій практиці та судових провадженнях використовують речові докази у вигляді електронних документів або їх цифрових зображень. Проблему автентифікації таких зображень ускладнено можливостями використання для підробки зображень редакторів на основі штучного інтелекту, що унеможливлюють або суттєво ускладнюють пошуки судовими експертами змінених ділянок. Науковою проблемою, розглянутою авторами, є оцінювання автентичності цифрових зображень на основі використання методів їх попереднього оброблення (фільтрації) і технологій штучного інтелекту для подальшого аналізу та визначення редагованих ділянок.

Метою роботи є розроблення інформаційної технології пошуку зон редагування на основі поєднання методів попереднього оброблення зображень і моделей нейронних мереж для використання у дослідженнях автентичності зображень.

Новизна роботи полягає у розробленні технології поєднання кількох методів попереднього оброблення зображень (зокрема, ELA та PCA) для створення вхідного потоку нейронної мережі глибокого навчання й оцінювання ефективності виявлення зон редагування, створених редактором цифрового живопису (Inpainting).

Розроблено та досліджено ефективність роботи 10 детекторів зон редагування, що використовують поєднання методів ELA та PCA з різними моделями нейронних мереж розпізнавання зон редагування. Найкращі результати (імовірність розпізнавання 0,916) у межах використаних обчислювальних ресурсів отримано детектором на основі моделі типу EfficientNet.

Розроблено й оцінено ефективність інформаційної технології та відповідного програмного забезпечення для оцінювання автентичності зображень на основі поєднання методів попереднього оброблення зображень і моделей штучних нейронних мереж у режимі семантичної класифікації та сегментації.

Ключові слова: *автентичність зображення; штучний інтелект; нейронні мережі; ELA; PCA; Inpainting.*

Аутентификация изображений на основе их семантической сегментации в нейронных сетях глубокого обучения с их предварительной обработкой методами фильтрации

Сергей Чёрный, Ольга Брендель, Давит Гратиашвили

В современной отечественной и международной досудебной практике и судебных разбирательствах используют вещественные доказательства в виде электронных документов или их цифровых изображений. Проблема аутентификации таких изображений осложняется существующими возможностями использования для подделки изображений редакторов на основе искусственного интеллекта, что делает невозможным или существенно усложняет поиски судебными экспертами изменённых участков.

Научной проблемой, рассмотренной авторами, является оценивание подлинности цифровых изображений на основе использования методов их предварительной обработки (фильтрации) и технологий искусственного интеллекта для дальнейшего анализа и определения отредактированных участков.

Целью работы является разработка информационной технологии поиска зон редактирования на основе сочетания методов предварительной обработки изображений и моделей нейронных сетей для использования в исследованиях подлинности изображений.

Новизна работы заключается в разработке технологии сочетания нескольких методов предварительной обработки изображений (в частности, ELA и PCA) для создания входного потока нейронной сети глубокого обучения и оценивания эффективности выявления зон редактирования, созданных редактором цифровой живописи (Inpainting).

Разработана и исследована эффективность работы 10 детекторов зон редактирования, использующих сочетания методов ELA и PCA с различными моделями нейронных сетей распознавания зон редактирования. Наилучшие результаты (вероятность распознавания 0,916) в пределах использованных вычислительных ресурсов получены детектором на основе модели типа EfficientNet.

Разработана и оценена эффективность информационной технологии и соответствующего программного обеспечения для оценивания подлинности изображений на основе сочетания методов предварительной обработки изображений и моделей искусственных нейронных сетей в режиме семантической классификации и сегментации.

Ключевые слова: *подлинность изображения; искусственный интеллект; нейронные сети; ELA; PCA; Inpainting.*

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Declaration of Competing Interest
The authors declare that they have no conflict of interest.

References

Blythe, P., Fridrich, J. (2004). *Secure digital camera. Digital Forensic Research Workshop* (Baltimore, USA, 11—13.08.2004).

Bobritskii, S. M., Chernyi, S. V. (2010). Metodicheskie aspekty kompleksnogo issledovaniia s tseliu vyiavleniia priznakov montazha v tsifrovoi fotografii [Methodological aspects of a Multidisciplinary Forensic Research in Order to Identify Signs of Montage in Digital Photography]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 10 [in Russian].

Chollet, F. Xception: *Deep Learning with Depthwise Separable Convolutions*. URL: https://arxiv.org/pdf/1610.02357.pdf.

Dmitriev, E. N. (2007). Metadannye kak sredstvo individualizatsii tsifrovykh izobrazhenii v sudebnoi fotografii [Metadata as Individualization Means of Digital Images in Forensic Photography]. *Teoriia i praktika sudebnoi ehkspertizy v sovremennykh usloviiakh* : mat-ly mezhdunar. nauch.-prakt. konf. Moskva [in Russian].

Dmitriev, E. N. (2009). Sudebnaia ehkspertiza fotograficheskikh izobrazhenii: sovremennoe sostoianie i vozmozhnosti resheniia ehkspertnykh zadach [Forensic Examination

of Photographic Images: State of the Art and Possibilities for Solving Expert Tasks]. *Sudebnaia ehkspertiza*. № 3 [in Russian].

Gurgul, K. (1973). Iz protsessualnoi i kriminalisticheskoi problematiki magnitofonnoi zapisi [From the procedural and forensic issues of tape recording]. *Sbornik perevodov*. № 213. Moskva [in Russian].

Hollien, H. (1994). *The Acoustics of Crime: The New Science of Forensic Phonetics*. Florida.

Kalenskyi, V. H. (2010). Doslidzhennia tsyfrovykh fotoznimkiv z metoiu vyiavlennia oznak montazhu [Research on Digital Photographs Using the Method of Revealing a Sign of Mounting]. *Sudova ekspertyza. Suchasnyi stan ta perspektyvy rozvytku* : mat-ly mizhnar. nauk.-prakt. konf. Kyiv [in Ukrainian].

Kobozeva, A. A. (2008). Ispolzovanie osobennostei vozmushchenii singuliarnykh chisel matritsy tsifrovogo izobrazheniia dlia obnaruzheniia ego falsifikatsii [Using Peculiarities of Disturbances of Singular Values of a Digital Image Matrix to Detect its Falsification]. *Iskusstvennyi intellekt*. № 1 [in Russian].

Krawetz, N. (2007). *A Picture's Worth... Digital Image Analysis and Forensics*. URL: https://www.hackerfactor.com/papers/bh-usa-07-krawetz-wp.pdf.

Mirskii, D. Ia. (1982). *Sudebnaia fototekhnicheskaia ehkspertiza* [Forensic photography]: metod. posob. dlia ehkspertov. Moskva [in Russian].

Problemy kriminalistiki (1971). Varshava. № 90 [in Russian].

Safonov, A. A., Kolotushkin, S. M., Kochubei, A. V. (2005). *Kompiuternye tekhnologii v kriminalisticheskoi fotografii: teoreticheskie i prikladnye voprosy* [IT in Forensic Photography: Theoretical and Applied Issues] : ucheb. posob. Volgograd [in Russian].

Silkin, P. F. (1979). *Sudebno-issledovatelskaia fotografiia* [Forensic Research Photography] : uchebnik. Volgograd [in Russian].

Wallace, G. K. (1991). *The JPEG Still Picture Compression Standard. IEEE Transactions on Consumer Electronics*.

Chornyy, S., Brendel, O., Gratiashvili, D. (2022). Authenticate images based on their semantic segmentation in deep learning neural networks with their pre-processing with use of filtering methods. *Theory and Practice of Forensic Science and Criminalistics.* Issue 1 (26). P. 125—137. DOI: 10.32353/khrife.1.2022.08.

Principles of forensic economics as a theoretical basis for its conducting

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Importance of studying principles of forensic economics is due to the need to interpret this economic and legal category in legislative field and determine the system-building factor for development of a normatively standardized approach to the methodology of such forensic examination.

Reliability of forensic economic examination results depends, in particular, on development level of its theoretical foundations. The purpose of this paper is to formulate the principles of forensic economic examination that are crucial in drawing up the expert's conclusion (in case of finding out the real state of financial statements of audited enterprise and its reliability that is or will be the subject of hearing).

Principles of forensic economics are analyzed and the need to develop sectoral principles of such science is substantiated. It is determined that general principles of forensic science (legality, independence, objectivity and completeness of the research) require further development in three areas: sectoral, organizational and methodological and in accordance with user requests.

Researches on specifics of forensic economics (taking into account user requests to asses financial enterprise state and financial statements) indicates the need to take into account during its accounting tools, which main are accounting estimates. Standardization of accounting while preparing financial statements allowed to identify principles influencing the formation of the

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expert's conclusion, namely: integrity, comparability, relevance, appropriateness, materiality (at the stage of functional measures of the examination) and effectiveness (at the stage of preparation and submission of expert conclusion).

Keywords: *forensic economics; principle; legality; accounting estimates; financial statements; accounting.*

Research Problem Formulation

Importance of forensic examination is due to the need to find out the real state of affairs during a particular trial. The practice of performing forensic economic examinations indicates an urgent issue: lack of reliable principles for the implementation of such forensic examination. There is an axiomatic approach to the policy of forensic science based on the norms of the current legislation, that spell out the actions of forensic examination. However, in order to limit the mission of forensic experts only to the norms of law would be to stop the development of expertise as a type of activity.

In the field of forensic economics, actions of forensic experts are significantly pressured, in particular by the rapid evolution of accounting and analytical science, for example, introduction in 2015 of National Accounting Standards in Public Sector (hereinafter referred to as NASPS) [1], International Financial Reporting Standards (hereinafter referred to as IFRS) [2], development of strategic accounting and the widespread use of the instrument of accounting estimates in the context of digitalization of accounting and reporting activities [3]. Let us consider the issue of quality of forensic economic examination through the prism of application of principles as the basic principles of its implementation in theoretical plane.

Article Purpose

Formulate the principles of forensic economics that are crucial in drawing up the expert's conclusion (in case of clarification of the real state of the financial statements of the audited enterprise and its reliability that is or will be the subject of hearing), taking into accounting estimates according to relevant accounting standards. Give certain recommendations, providing the following researchers grounds for resolving the question of the principles of forensic economics as its theoretical foundations.

Analysis of Essential Researches and Publications

With explanatory and encyclopedic dictionaries, the *principle* term in Latin means: base, primary source. According to

1 Колєсніченко А. С. Інституціональні аспекти модернізації системи бухгалтерського обліку та фінансової звітності в державному секторі. *Review of transport economics and management*. 2020. № 4 (20). С. 136—143. DOI: 10.15802/rtem2020/228859 (date accessed: 18.01.2022).

2 Голобородько Т. В. Використання міжнародних стандартів фінансової звітності у зарубіжних країнах. *Ефективна економіка.* 2016. № 10. URL: https://www.economy.nayka.com.ua/?op=1&z=5293 (date accessed: 18.01.2022).

3 Стратегія модернізації системи бухгалтерського обліку та фінансової звітності в державному секторі на період до 2025 року : схвал. розпорядж. КМУ від 20.06.2018 р. № 437-р. URL: https://zakon.rada.gov.ua/laws/show/437-2018-%D1%80#Text (date accessed: 18.01.2022).

basic concepts formed both in philosophy and in special sciences, ***principles*** are basic provisions, principles, rules, norms, requirements, that is, semantically similar concepts that scientists and legislators interpret in a broad sense (*basics, regulations, principles*) or in a narrow (*rules, norms, requirements*) [4].

According to many practitioners, the theoretical foundations of forensic economic expertise are disclosed in the current legislation. Thus, Art. 3 of the Law of Ukraine: *On Judicial Examination* (hereinafter referred to as *Specialized Law*) stipulates that forensic activities are carried out *"on the principles of legality, independence, objectivity and completeness of research"* [5].

The draft laws published at different times for the most part significantly expanded the list of principles for implementation of forensic science activity.

One of the draft laws on forensic science activity[6] provides for a number of general principles, taking into account (in addition to principles defined by the current Specialized Law [7]) the methods and objects of forensic examination (it is permissible to use methods of conducting and maximum preservation of forensic objects). Other projects proposed to add the principles of professional ethics of the expert, scientific validity, observance of human and civil rights and freedoms, political neutrality, etc. The principles of forensic science proposed by these draft laws helped to reflect the professional position of each group of authors who prepared amendments to legislation and demonstrated a tendency to expand the range of examination tasks depending on the subject of the study. However, currently in the scientific community there is no consensus on defining the principles of both the entire forensic examination and its individual types (in particular, economic one).

The normative line of research on forensic science principles (supplementation of the principles defined by the Specialized Law) is shared by the majority of researchers. Thus, N. I. Klymenko [8] adds to the existing principles of purposefulness, planning and systematicity, Zh. A. Kevorkova [9]: compliance, efficiency, systematization and complexity of expert research. The issues of principles have been discussed since the beginning of forensic science [10], leaving its basic principles (legality, independence and objectivity) unchanged[11].

It is worth paying attention to the fact that the development of principles (as a basis for the implementation of

4 Артюх О. В. Принципи контролю: проблематика визначення. *Науковий вісник Ужгородського національного університету. Серія: Міжнародні економічні відносини та світове господарство*. 2016. Вип. 6. Ч. 1. С. 20—25. URL: https://nbuv.gov.ua/UJRN/Nvuumevcg_2016_6%281%29__7 (date accessed: 18.01.2022).

5 Про судову експертизу : Закон України від 25.02.1994 р. № 4038-XII (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/4038-12#Text (date accessed: 18.01.2022).

6 Проєкт Закону про судово-експертну діяльність від 05.11.2021 р. № 6284. URL: https://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=73154 (date accessed: 01.02.2022).

7 Про судову експертизу : Закон … . URL: https://zakon.rada.gov.ua/laws/show/4038-12#Text (date accessed: 18.01.2022).

8 Клименко Н. И. Криминалистика как наука : монография. Киев, 1997. 83 с.

9 Кеворкова Ж. А. Судебно-бухгалтерская экспертиза : монография. Москва, 2005. 127 с.

10 Шляхов А. Р. Судебная экспертиза: организация и проведение. Москва, 1979. 168 с.

11 Волкова І. А. Судово-бухгалтерська експертиза : навч. посіб. Київ, 2009. 84 с.

expert actions) acquires a clear sectoral direction depending on the directions of development of forensic expertise. Thus, V. D. Ponikarov singled out the differentiation and integration of specific expertise, which for his part, determines the need to identify the relevant principles already at the level of forensic economics.

The theoretical basis of such principles was laid by M. T. Bilukha [12] coryphaeus of forensic economics. In conducting research, they are used to nowadays, but more as a historical abstraction, because provision of practical recommendations involves primarily the use of current principles of forensic science, provided by the relevant Law. At the same time, over the past 10 years, scholars have developed specific issues of forensic economic expertise, which led to the development of principles in the direction of their adaptation to specific expertise. T. M. Rybkina and O. V. Khomutenko [13], O. V. Anishchenko and O. L. Danylchenko [14], analyzing the basic approaches to determining damages in criminal proceedings, focused on their regulation for the examination. This opinion is shared by O. V. Fomina and I. K. Shushakova [15] in research paper on the use of forensic economic expertise in tax disputes on transfer pricing, and M. Khouk in a book on the impact of digitalization on forensic science activities[16]. Practical recommendations provided by scientists on the components of evidence base and mandatory elements of forensic economics that they called economic analysis, facts (circumstances), electronic environment and legal component (tax legislation), are also based solely on the principles of applicable law. This is what the authors consider an effective tool for resolving pre-trial or investigative conflicts of interest in matters of tax disputes over transfer pricing. The same opinion of T. O. Krivtsova on the use of basic principles for solving practical issues of forensic economics in the tax field [17]. In other sectoral areas of application of the subject of forensic economic examination are considered according to traditional principles: D. O. Hrytsyshen and O. V. Kuznietsova (on the assessment of waste management operations) [18], S. V. Ievdokimenko (in the context of the practical development of

12 Білуха М. Т. Судово-бухгалтерська експертиза : підручник. Київ, 2004. С. 35.

13 Рибкіна Т. М., Хомутенко О. В. Місце судово-економічної експертизи в процесі встановлення шкоди та збитків. *Теорія та практика судової експертизи і криміналістики*. 2008. Вип. 8. С. 480—483.

14 Аніщенко О. В., Данильченко О. Л. Збитки як предмет судової економічної експертизи у кримінальному провадженні. *Теорія та практика судової експертизи і криміналістики.* 2019. Вип. 20. С. 367—377. DOI: 10.32353/khrife.2.2019.28 (date accessed: 05.02.2022).

15 Фоміна О. В., Шушакова І. К. Судова економічна експертиза з питань трансфертного ціноутворення. *Економіка України.* 2021. № 10 (719). С. 52—66. DOI: 10.15407/economyukr.2021.10.052 (date accessed: 18.01.2022).

16 Houck M. Digital and Document Examination. 2018. 264 p. URL: https://www.elsevier.com/books/digital-and-document-examination/houck/978-0-12-802717-2 (date accessed: 05.02.2022).

17 Крівцова Т. О. Судово-економічна експертиза розрахунків, пов'язаних із податком на доходи фізичних осіб: теоретико-методологічні аспекти. *Економіка розвитку*. 2015. № 1 (73). С. 46—53. URL: https://nbuv.gov.ua/UJRN/ecro_2015_1_8 (date accessed: 05.02.2022).

18 Грицишен Д. О., Кузнєцова О. В. Судова економічна експертиза операцій з управління відходами: теоретичні положення. *Вісник Житомирського державного технологічного університету. Серія: Економічні науки*. 2013. № 4 (66). С. 30—38. URL: https://nbuv.gov.ua/UJRN/Vzhdtu_econ_2013_4_5 (date accessed: 18.01.2022).

forensic science in combating offenses in banking operations) [19].

V. A. Derii and D. I. Dema, developing the ideas of M. T. Bilukha, put forward the thesis of uniqueness of forensic economics in terms of identifying the "correct" its objects (unlike other species of forensic science), which the authors consider the financial condition of enterprises, property and sources of its acquisition, current assets and sources of their formation, sources of own funds and results of financial and economic activities of enterprises, general and special funds, settlements with debtors and creditors [20], etc. This latest concept of forensic economic examination is based on the classification of forensic economic examinations by H. A. Matusovskyi, according to him the principles undergo significant changes depending on forensic examination objects . Researchers propose to start training professionals in Ukraine majoring in *Forensic economics and Audit*. In our opinion, these researches (although they reflect the needs and requests of users) are somewhat remote-idealistic in nature, as they do not fully take into account realities of current legislation on forensic science.

In professional readings, a group of authors identifies the so-called methodological principles of examination in accounting [21]. Unification of theoretical provisions of forensic science requires development of qualitative characteristics that would reflect criteria of usefulness of information formed and collected while research on accounting documents. Therefore, scholars argue that such principles should be based on the principles of accounting, auditing and control through industry approaches to expertise in this area. Therefore, principles of objectivity, competence, consistency, monetary valuation, reliability, reporting period, comparability, materiality, effectiveness reproduce accounting principles reflected in the standards and at the same time duplicate the legal requirements for forensic examination. Indeed, I. V. Pyrih and I. R. Shynkarenko note that *"principle of objectivity is to establish the laws of forensic expertise solely on the basis of the study of objects using special knowledge, regardless of social, political and other processes taking place. in society"*[22]. The authors conclude that *"this does not mean creating science to meet the needs of those who allocate financial resources"*. Therefore, at methodological level, in our opinion, it is enough to reflect the methods of forensic examination taking into account the specific methods and objects of forensic examination.

At the same time, I. V. Pyrih and I. R. Shynkarenko take the position of distinguishing principles of forensic science from principles of forensic science activity considering most of the

19 Євдокіменко С. В. Судово-економічна експертиза у протидії правопорушенням у банківській сфері . *Право і Безпека*. 2015. № 4. С. 77—83. URL: https://nbuv.gov.ua/UJRN/Pib_2015_4_17 (date accessed: 18.01.2022).

20 Дерій В. А., Дема Д. І. Економічна експертиза діяльності підприємств. *Економіка та суспільство*. 2017. Вип. 11. С. 508—514.

21 Дрейден В. Г. Основные вопросы документальной ревизии и судебно-бухгалтерской экспертизы в работе следователя : учеб пособ. Ленинград, 1969. 169 с. ; Грицишен Д. О., Кузнєцова О. В. Op. cit. URL: https://nbuv.gov.ua/UJRN/Vzhdtu_econ_2013_4_5 (date accessed: 18.01.2022).

22 Пиріг І. В., Шинкаренко І. Р. Принципи судової експертизи (*оглядова стаття*). *Теорія та практика судової експертизи і криміналістики*. 2018. Вип. 18. С. 221—230. DOI: 10.32353/khrife.2018.24 (date accessed: 18.01.2022)

principles (Specialized Law and those proposed by scholars) to reflect "mostly the basics of procedural law (procedural independence and autonomy). expert, separation of expert functions from the functions of other procedure participants, personal responsibility of forensic expert for provided conclusion)" [23].

In order to determine a specific list of principles of forensic economics, it is necessary to refer to its purpose that is the evidence formation of base during the trial of an economic offense[24]. For this purpose, the effectiveness principle should work, the essence of which is the effectiveness of the final stage of forensic examination, achievement of concrete results. Regarding forensic research, E. B. Simakova-Yefremian emphasizes this [25].

In forensic science examination, effectiveness is achieved when the expert's conclusion contains answers to questions on the merits, which should not be rejected by the court or the parties. Rejection of the expert's conclusion is often possible due to the incompetence of the expert, his interest or poor quality examination[26]. Thereby T. V. Pashchenko and T. H. Sheshukova add to the principles mentioned above, the integrity principle that according to many scholars, not only ensures the quality of forensic science but determines independence of conclusions formulated by forensic expert.

Indeed, forensic examination of financial statements and accounting is associated with inevitable issues of analyzing appropriateness of the use of specific accounting tools, such as accounting estimates and recognition of assets to reflect them in the reporting. Because science and practice still do not have a single approach to analysis, analysts use accounting data differently. This is unacceptable in forensic science. Therefore, we formed a different approach, which was defined as the purpose of this study. *Firstly*, we demonstrate how accounting is related to accounting, providing a starting point for the study of accounting (according to users of accounting and reporting). These formal expressions for forensic science are limited to the statement of factual indicators reflected in accounting and reporting. *Secondly*, we formulate basic foundations of forensic economic expertise: by outlining a set of principles of *best practices* for forensics that provide the information required by the judiciary. *Thirdly*, we impose these principles of *best practices* on the information structure in order to draw conclusions about the principles of forensic economics supporting the practice. Thus, through the needs of users, the principles of evaluation, analysis principles taking into account the principles of accounting, we come to the definition of the principles of forensic economics.

Main Content Presentation

Unlike accountants and auditors, forensic experts still do not have forensic standards. The standards are designed to promote, above all, transparent organizational and methodological support in the field

23 Ibid. C. 228.

24 Пащенко Т. В., Шешукова Т. Г. Развитие теории и практики бухгалтерской экспертизы : монография. Пермь, 2010. 170 с.

25 Сімакова-Єфремян Е. Б. Комплексні судово-експертні дослідження: теорія та практика : монографія. Харків, 2016. 456 с.

26 Пащенко Т. В., Шешукова Т. Г. Развитие теории и практики бухгалтерской экспертизы : монография. Пермь, 2010. 170 с.

of forensic science, a unified approach to working with physical evidence, forensic examinations, uniformity of measurements, technical and information compatibility, comparability of research results, unification in the field of forensic science activity, etc. [27] Some methods of expert research, approaches to work with physical evidence no longer meet modern requirements. This is partly due to difficulty of adapting to changing conditions of the approaches formed in the 1960s and 1970s and partly due to the risk environment conditions . The basis of the issue is the lack of unity and coherence of the norms of modern forensic economics. Basic conceptual approaches begin with goals and concepts. They stipulate the principles of recognition and evaluation. "Recognition" determines what the forensic economist should consider during the examination of financial statements and "assessment"– how to assess its performance. Sequence of ideas looks as Fig. 1 indicates.

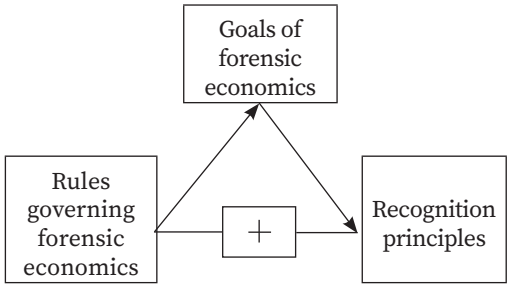

Fig. 1. Ensuring achievement of goals of forensic economics and interdependence of elements

Although standardization procedure of forensic science in Ukraine continues [28], it does not demonstrate any results. We assume that even if the goals and concepts of forensic science are adopted nowadays, their too wide range will prevent the solution of basic principles of forensic economic examination of accounting and financial reporting, because they are in no way related to what users expect from an expert in accounting and financial statements. At the recognition stage, they determine forensic expert approach to the assets and liabilities to be examined. This approximates the legal approach that links forensics to these definitions rather than to the needs of users, and draws experts into a web of individual details instead of interpreting definitions. Difficulties prevail in characterizing performance of forensic economics.

We have applied utilitarian approach: we examine accounting policies, accounting and financial reporting from the user's point of view (in particular, investigator who uses the fundamental assessment of forensic expert for investigation and proceedings). The enterprise value is estimated using accounting indicators - such as sales, profit, debt at the reporting date (balance sheet date), etc. Indeed, a fundamental assessment by forensic expert is sometimes seen as a verification of accounting information. However, verification is a misinterpretation of procedure essence of forensic economic examination. On the contrary, forensic expert should certify the actual state of affairs with reference to documentary accounting information. However,

27 Рувін О. Г., Полтавський А. О. Становлення стандартизації судово-експертного забезпечення правосуддя в Україні: перспективи розвитку. *Стандартизація, сертифікація, якість*. 2018. № 3 (110). С. 39—47.

28 Про створення технічного комітету стандартизації «Судова експертиза» : наказ ДП «Укр-НДНЦ» від 07.05.2018 р. № 125. URL: https://ips.ligazakon.net/document/FN042150 (date accessed: 18.01.2022).

questions arise : "To what extent does this accounting meet users' expectations?", "Is this accounting at fair value?", "Is this accounting at cost?". Instead of appealing to accounting concepts such as the balance sheet approach, or calling "fair value" or "historical cost" an (inappropriate) "attribute of valuation", we ask, "What should an investigator know about a trial?" . This approach considers financial reporting to be a product, so the problem of accounting expertise is to develop a product that is tailored to the needs of users and should answer the question: "Is it correct, in the opinion of users of reporting, to ensure the preparation of reports, whether the relevant principles of reporting and forensic examination are followed?".

For the stated purposes of forensic economic expertise, within its conceptual limits, the user of the examination results means the subjects of litigation, and the users of financial statements; traditionally external and internal entities, including owners, investors and other users. This is confirmed by financial reporting goals in accordance with IFRS and NASPS.

It is necessary to start teaching information on data analysis while forensic examination from the principles guided by the expert - the so-called principles of best practices. In default of approved standards of forensic science (in particular, forensic economics), we do not choose the principles ourselves but rather involve those defined by the law on forensic science and described in the fundamental analytic research papers: forensic experts for many previous years. These are principles that the analyst is unlikely to agree with; we really consider them generally accepted. However, the acceptance of these principles largely depends on the understanding of what these principles mean for practice compared to the alternatives that can be offered. Principles of forensic economics should be relevant, or at least not contradict the approach defined by IFRS, NASPS. Therefore, instead of a priori determining the desired *quality characteristics* of information, we conclude about these characteristics based on user requests (rather than owners, as declared in the standards).

Unlike the concepts of these standards, the principles we proposed are reduced to actions to assess reliability of accounting information.

Let us explain this with an example. One of the most important issues of accounting policy is the controversial choice of *balance sheet approach* over the *statement of financial performance* (in international practice it is called *income statement*). Indeed, accounting estimates vary widely depending on nature of accounting entity (as required by standards, they must be performed by management if monetary amounts cannot be determined directly): *"Valuation of these monetary amounts depends on the uncertainty of valuation reflecting inherent limitations of knowledge or data"*[29]. The forensic economist's analysis is not necessarily conclusive: this analysis could be compared to alternatives that could arise from a different accounting estimate.

The main purpose of conceptual framework documents of accounting and reporting standards is to provide information on future cash flows. At the same time, the stated goal does not indicate how to do it: balance sheets,

29 Міжнародні стандарти аудиту. Міжнародні стандарти контролю якості, аудиту, огляду, іншого надання впевненості та супутніх послуг. Вид. 2016—2017 рр. Ч. І: Аудит облікових оцінок та пов'язане з ними розкриття інформації : Міжнар. стандарт аудиту 540 (переглянутий). URL: https://mof.gov.ua/uk/mizhnarodni-standarti-auditu/ (date accessed: 11.01.2022).

income statements (profit and loss) and their details are probably important, but how do these financial statements relate to future cash flows and their value? We will demonstrate this by example of accounting cost models. The first is the standard residual income model that links accounting to the equity cost. The second is the expression that links stock returns to accounting figures. When it comes to investing in equity, the cash flows that board wants to forecast are dividends: cash flows for shareholders. The standard dividend discounting model reflects the following calculation:

$$Value_0 = \frac{Dividend_1}{(1+r)} + \frac{Dividend_2}{(1+r)^2} + \frac{Dividend_3}{(1+r)^3} + \ldots$$

where *r* is discount rate (required return on risk).

The dots at the end of the above formula indicate that for continuous enterprise operation, forecasts are estimated to be maintained indefinitely in the future. Variables with a lower index of t > 0 are expected values of the base period and in subsequent periods. This model does not cause disagreements: it contains the principle which a reliable assessment of forensic expert should be based on, that means expediency of applying a specific accounting model. The main thing is to associate accounting indicators with the expected dividends, therefore, with their value. Accounting, in fact, reflects in the statements information about net profit, both according to the balance sheet (section I of the liability) and in the statement of financial results (profits and losses). Therefore, the expediency principle is one of the important principles at the stage of record keeping and compiling.

Since an accounting estimate is an amount in cash equivalent that depends on the estimate uncertainty [30], forensic expert should state only the facts of estimate application. Accounting should clearly reflect total income, as the equivalence of estimates based on the final financial result occurs only when the profit reflects total calculation of all correctly valued assets and transactions (E.g., principle of compliance in Fig. 2 below).

The use of assets by forensic expert in accounting for revaluation (revaluation) is always limited to whether such estimates are consistent with the fair value of a particular reporting period. "To what extent do estimates take into account future risks and how is this reflected in the financial statements?" This is the most important recognition issue of principles in accounting, which complementing the recognition issue of accounting and reporting conceptual basis.

The purpose of applying the conceptual framework of any standard is to provide information about amount and uncertainty of future cash flows. Cost is the present value of projected cash flows, discounted for uncertainty, so another possible aspect of accounting is to provide information about discount rate.

The discount rate is called the capital cost , or expected return on risk. However, although these terms relate accounting to prices, revenue, and expected revenue, they are not used in reporting and accounting. Only some companies can provide such information in the *Notes to the annual financial statements*, but there are no regulatory requirements. Thus, using the concept of user orientation, forensic economist can identify a number of practical principles; that will determine the basic approaches in terms of individual organizational stages of

30 Ibid.

forensic science but in any case should reflect sectoral specifics of forensic examination itself. In our study, it is an economic examination which object is accounting and reporting.

Indeed, results of forensic economic examinations play an important role in the overall structure of evidence in criminal proceedings and therefore require formation of a clear theoretical basis for the conduct of relevant researches [31]. Conceptual basis of IFRS (and other accounting standards) begins with principles (*relevance, reliable presentation* and *neutrality*) defining characteristics of provided information . We start with the principles that characterizing information but these are principles related to the demand for information within the general objectives of forensic economics using the established forensic classification (identification, diagnostic, preventive) [32].

The standard thesis of fundamentalists [33]: price is what you pay, value is what you get [34]. Unlike those who view prices as an effective measure of fair value, fundamentalists view price as speculative and potentially different from value. Therefore, adherence to the principles is important to reconcile the degree of riskiness of estimates taking into account market prices: choice and application of methods, significant assumptions and data used by management to carry out accounting estimates; selection of a point assessment and disclosure of relevant information about the uncertainty of assessment by management [35].

The first two principles specify concepts of relevance and reliability that prevail in accounting standards. These concepts are often trade-offs: in order to become relevant, evaluation information becomes less reliable (abandonment of the reliability principle is considered as normal one). The fundamentalist argues that speculative information (that can be relevant to the case) should not be confused with reliable information, as he relies on this reliable information to challenge speculative stock prices. Fundamentalist understands that prices are speculative and seeks to obtain reliable accounting reports to consolidate the assessment. Fundamentalist implicitly urges the accountant: tell me what you know, and leave the assumptions to me. The accountant provides information for the first component of the financial statements - the balance sheet, but should not distort the information on income and expenses when preparing the second form of reporting: *Statement of financial performance*. Therefore, in development of S. A. Zviahin's [36] proposal to supplement principles of forensic economics with the principle of comparability (based

31 Войтенко О. О., Гуріна Д. П. До питання про об'єкт судової економічної експертизи. *Актуальні питання стандартизації судово-експертного забезпечення правосуддя в Україні. Перспективи розвитку* : мат-ли міжнар. наук.-практ. конф., присвяч. 105-річ. судов. эксперт. в Укр. та 95-річ. з дня народж. акад. М. Я. Сегая. (Київ, 04—05.07.2018). Київ, 2018. С. 80—83.

32 Дікань Л. В., Понікаров В. Д., Кожушко О. В. Судово-економічна експертиза : навч. посіб. Харків, 2014. 432 с.

33 Fundamentalists (Latin: *Fundamentum* – basis): advocates of norms and standards.

34 Цвейґ Дж., Ґрем Б. Розумний інвестор. Стратегія вартісного інвестування / пер. з англ. О. Кальнова. Київ, 2019. 544 с.

35 Міжнародні стандарти аудиту ... . URL: https://mof.gov.ua/uk/mizhnarodni-standarti-auditu/ (date accessed: 11.01.2022).

36 Звягин С. А. Развитие методологии и методики бухгалтерской экспертизы : дис. ... д-ра экон. наук. Воронеж, 2009. 381 с.

on accounting rules and relationships, based on the comparison of income and expenses), we will add to the justification a mandatory component for comparability of accounting estimates with the interests of users and the risks of future cash inflows in conditions of uncertainty.

Principle of correspondence is known both in the philosophical aspect of scientific research and in quantum physics, mathematics and economics. The regulation of accounting at the legislative level determines the principles of its maintenance ensuring preparation of financial statements. Such principles include principles of full coverage, autonomy, consistency, continuity, accrual, precedence of the essence over the form, a single monetary measure, etc., defined by IFRS, or NASPS depending on which of these standards the enterprise applies [37].

An approach based on the statement of financial performance (with emphasis on profit measurement) is not only an alternative to the cost approach in the balance sheet, but contributes to correcting the imperfect balance sheet. The impact of accounting estimates on reliability of reporting data indicates that principle of materiality is also important in construction of a theoretical platform for performing forensic economic examination. The lack of materiality (as the value of the information) can affect validity and expert conclusion and necessitates taking into account all data affecting the reporting (*E.g.,* Fig. 2 on p. 149).

Application of accounting estimates is the basic method of reflecting in accounting and reporting of all transactions, so the above findings confirm the need to add to principles of economics the comparability principle that will provide adequate assessment for forensic examination purposes.

The advantage of applying a wider range of principles grouped by organizational stages of forensic expert research in the economy (Fig. 2), is procedure integration according to research topic.

Conclusions

To basic principles of forensic economics stipulated at legislative level, it is proposed to add the principles of integrity, comparability, compliance, feasibility, materiality (at the stage of functional examination measures) and effectiveness (at the stage of drawing up and providing forensic expert conclusion). These principles affect expert conclusion formation and will facilitate preparation of such conclusion taking into account user requests to assess the financial enterprise state and data about financial statements, as well as accounting tools, the main among which are accounting estimates.

Certainly, the proposed structure of principles of forensic economics is not ideal and does not definitively solve theoretical issues of performing such examination but it can be used as a basis for further scientific and methodological research in this direction.

Принципи судової економічної експертизи як теоретичне підґрунтя її проведення

Володимир Іванков

Важливість дослідження принципів судової економічної експертизи зумовлено потребою інтерпретувати цю еко-

37 Про бухгалтерський облік та фінансову звітність в Україні : Закон України від 16.07.1999 р. № 996-XIV (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/996-14?find=1&text=%D0%BF%D1%80%D0%B8%D0%BD%D1%86%D0%B8%D0%BF#w1_1 (date accessed: 18.01.2022).

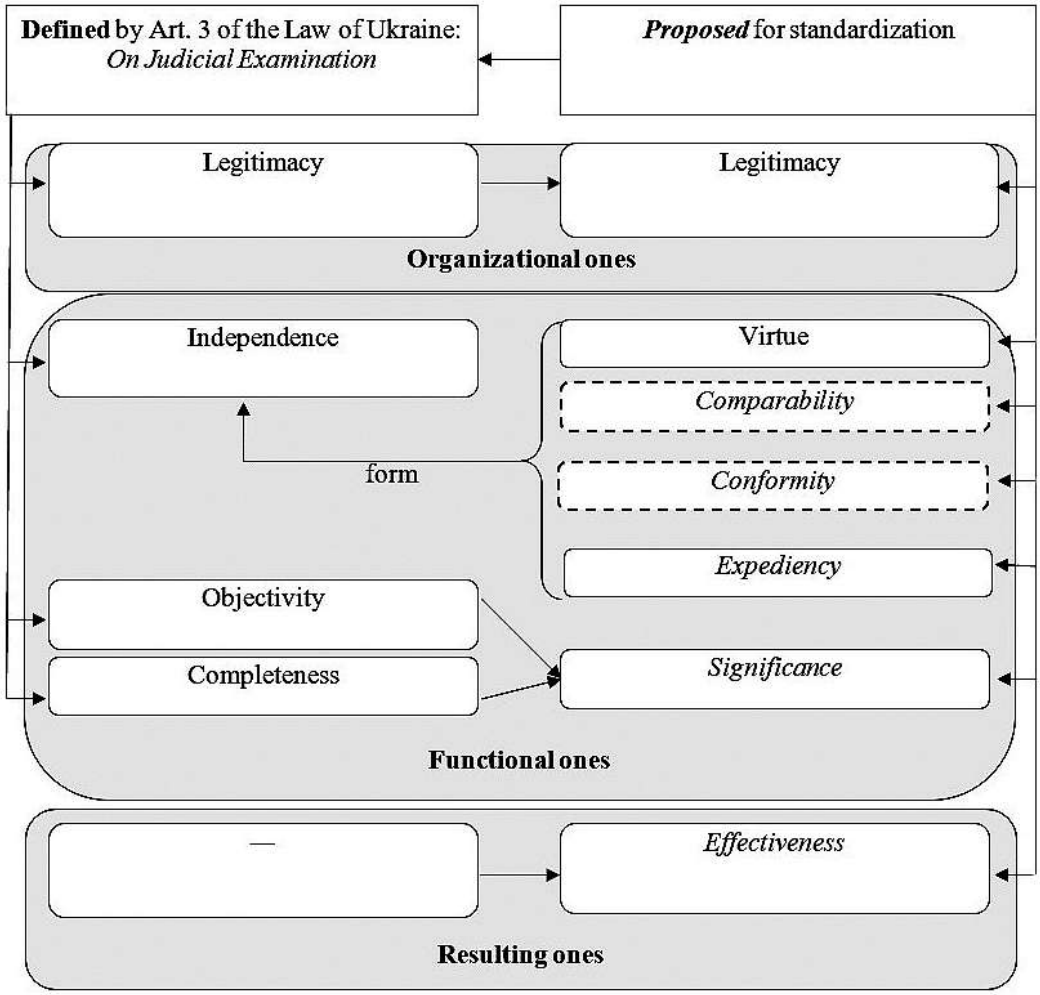

Fig. 2. Classification of principles of forensic economics (*emphasis added*, proposed by author)

номіко-правову категорію в законодавчому полі та визначити системотворчий чинник для вироблення нормативно-стандартизованого підходу до методології такої експертизи.

Достовірність результатів судово-економічної експертизи залежить, зокрема, від рівня розробленості її теоретичних засад. Мета цієї роботи — сформулювати принципи судової економічної експертизи, які мають вирішальне значення під час складання висновку експерта (у разі з'ясування реального стану фінансової звітності підприємства, яке перевіряють, і її достовірності, що є або може стати предметом судового розгляду).

Проаналізовано принципи судової економічної експертизи й обґрунтовано необхідність розробити галузеві принципи такої експертизи. Визначено, що загальні принципи судової експертизи (законності, незалежності, об'єктивності й повноти дослідження) потребують подальшого розвитку за трьома напрямами: галузевим, організаційно-методичним і відповідно до запитів користувачів.

Дослідження специфіки виконання судово-економічної експертизи (з урахуванням запитів користувачів щодо оцінки фінансового стану підприємства й даних фінансової звітності) свідчить про необхідність враховувати під час її проведення облікові інструменти, основний поміж яких — облікові оцінки. Стандартизація обліку під час складання фінансової звітності дала змогу виокремити принципи, що впливають на формування висновку експерта, а саме: доброчесності, співставності, відповідності, доцільності, суттєвості (на етапі функційних заходів проведення експертизи) і результативності (на етапі складання та надання висновку експерта).

Ключові слова: *судова економічна експертиза; принцип; законність; облікові оцінки; фінансова звітність; бухгалтерський облік.*

Принципы судебной экономической экспертизы как теоретическая основа её проведения

Владимир Иванков

Важность исследования принципов судебной экономической экспертизы предопределена необходимостью интерпретировать эту экономико-правовую категорию в законодательном поле и определить системообразующий фактор для выработки нормативно-стандартизированного подхода к методологии такой экспертизы.

Достоверность результатов судебно-экономической экспертизы зависит, в частности, от уровня разработанности её теоретических принципов. Цель этой работы — сформулировать принципы судебной экономической экспертизы, имеющие решающее значение при составлении заключения эксперта (в случае установления реального состояния финансовой отчётности проверяемого предприятия и её достоверности, которая является или будет являться предметом судебного рассмотрения).

Проанализированы принципы судебной экономической экспертизы и обоснована необходимость разработать отраслевые принципы такой экспертизы. Определено, что общие принципы судебной экспертизы (законности, независимости, объективности и полноты исследования) нуждаются в дальнейшем развитии по трём направлениям: отраслевому, организационно-методическому и в соответствии с запросами пользователей.

Исследование специфики выполнения судебно-экономической экспертизы (с учётом запросов пользователей по оценке финансового состояния предприятия и данных финансовой отчётности) показало необходимость учитывать при её проведении учётные инструменты, основной среди которых — учётные оценки. Стандартизация учёта при составлении финансовой отчётности позволила выделить принципы, влияющие на формирование заключения эксперта, а именно: порядочности, сопоставимости, соответствия, целесообразности, существенности (на этапе функциональных мероприятий проведения экспертизы) и результативности (на этапе составления и предоставления заключения эксперта).

Ключевые слова: *судебная экономическая экспертиза; принцип; законность; учётные оценки; финансовая отчётность; бухгалтерский учёт.*

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References

Anishchenko, O. V., Danylchenko, O. L. (2019). Zbytky yak predmet sudovoi ekonomichnoi ekspertyzy u kryminalnomu provadzhenni [Losses as a subject to legal economic examination in criminal proceedings]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 20. DOI: 10.32353/khrife.2.2019.28 [in Ukrainian].

Artiukh, O. V. (2016). Pryntsypy kontroliu: problematyka vyznachennia [Principles of control: problems of definition]. *Naukovyi visnyk Uzhhorodskoho natsionalnoho universytetu. Seriia: Mizhnarodni ekonomichni vidnosyny ta svitove hospodarstvo*. Vyp. 6. Ch. 1. URL: https://nbuv.gov.ua/UJRN/Nvuumevcg_2016_6%281%29__7 [in Ukrainian].

Bilukha, M. T. (2004). *Sudovo-bukhhalterska ekspertyza* [Forensic accounting] : pidruchnyk. Kyiv [in Ukrainian].

Derii, V. A., Dema, D. I. (2017). Ekonomichna ekspertyza diialnosti pidpryiemstv [Economic expertise of enterprises activity]. *Ekonomika ta suspilstvo*. Vyp. 11 [in Ukrainian].

Dikan, L. V., Ponikarov, V. D., Kozhushko, O. V. (2014). *Sudovo-ekonomichna ekspertyza* [Forensic economics] : navch. posib. Kharkiv [in Ukrainian].

Dreiden, V. G. (1969). *Osnovnye voprosy dokumentalnoi revizii i sudebno-bukhgalterskoi ehkspertizy v rabote sledovatelia* [The main issues of documentary audit and forensic accounting in the investigator's work] : ucheb. posob. Leningrad [in Russian].

Fomina, O. V., Shushakova, I. K. (2021). Sudova ekonomichna ekspertyza z pytan transfertnoho tsinoutvorennia [Forensic economic examination of transfer pricing]. *Ekonomika Ukrainy*. № 10 (719). DOI: 10.15407/economyukr.2021.10.052 [in Ukrainian].

Holoborodko, T. V. (2016). Vykorystannia mizhnarodnykh standartiv finansovoi zvitnosti u zarubizhnykh krainakh [The use of international financial reporting standards in foreign countries]. *Efektyvna ekonomika*. № 10. URL: https://nbuv.gov.ua/UJRN/efek_2016_10_49 [in Ukrainian].

Houck, M. (2018). *Digital and Document Examination*. URL: https://www.elsevier.com/books/digital-and-document-examination/houck/978-0-12-802717-2.

Hrytsyshen, D. O., Kuznietsova, O. V. (2013). Sudova ekonomichna ekspertyza operatsii z upravlinnia vidkhodamy: teoretychni polozhennia [Forensic economic examination of waste

management operations: theoretical provisions]. *Visnyk Zhytomyrskoho derzhavnoho tekhnolohichnoho universytetu. Seriia: Ekonomichni nauky.* № 4 (66). URL: https://nbuv.gov.ua/UJRN/Vzhdtu_econ_2013_4_5 [in Ukrainian].

Kevorkova, Zh. A. (2005). *Sudebno-bukhgalterskaia ehkspertiza* [Forensic accounting] : monografiia. Moskva [in Russian].

Klimenko, N. I. (1997). *Kriminalistika kak nauka* [Criminalistics as science] : monografiia. Kiev [in Russian].

Koliesnichenko, A. S. (2020). Instytutsionalni aspekty modernizatsii systemy bukhhalterskoho obliku ta finansovoi zvitnosti v derzhavnomu sektori [Institutional aspect of modernization of the accounting and financial reporting system in the public sector]. *Review of transport economics and management.* № 4 (20). DOI: 10.15802/rtem2020/228859 [in Ukrainian].

Krivtsova, T. O. (2015). Sudovo-ekonomichna ekspertyza rozrakhunkiv, poviazanykh iz podatkom na dokhody fizychnykh osib: teoretyko-metodolohichni aspekty [Judicial and economic expertise of calculations connected with the personal income tax: theoretical and methodological aspects]. *Ekonomika rozvytku.* № 1 (73). URL: https://nbuv.gov.ua/UJRN/ecro_2015_1_8 [in Ukrainian].

Pashchenko, T. V., Sheshukova, T. G. (2010). *Razvitie teorii i praktiki bukhgalterskoi ehkspertizy* [Development of theory and practice of forensic accounting] : monografiia. Perm [in Russian].

Pyrih, I. V., Shynkarenko, I. R. (2018). Pryntsypy sudovoi ekspertyzy (ohliadova stattia) [Principles of forensic science]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky*. Vyp. 18. DOI: 10.32353/khrife.2018.24 [in Ukrainian].

Ruvin, O. H., Poltavskyi, A. O. (2018). Stanovlennia standartyzatsii sudovo-ekspertnoho zabezpechennia pravosuddia v Ukraini: perspektyvy rozvytku [The formation of standardization of forensic expert support of justice in ukraine: development prospects]. *Standartyzatsiia, sertyfikatsiia, yakist*. № 3 (110) [in Ukrainian].

Rybkina, T. M., Khomutenko, O. V. (2008). Mistse sudovo-ekonomichnoi ekspertyzy v protsesi vstanovlennia shkody ta zbytkiv [Place of forensic economics while establishing damage and damages]. *Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky.* Vyp. 8 [in Ukrainian].

Shliakhov, A. R. (1979). *Sudebnaia ehkspertiza: organizatsiia i provedenie* [Forensic examination: organization and conducting]. Moskva [in Russian].

Simakova-Yefremian, E. B. (2016). *Kompleksni sudovo-ekspertni doslidzhennia: teoriia ta praktyka* [Complex forensic research: theory and practice] : monohrafiia. Kharkiv [in Ukrainian].

Tsveig, Dzh., Grem, B. (2019). *Rozumnyi investor. Stratehiia vartisnoho investuvannia* [The Intelligent Investor Rev Ed.: The Definitive Book on Value Investing] / per. z anhl. O. Kalnova. Kyiv [in Ukrainian].

Voitenko, O. O., Hurina, D. P. (2018). Do pytannia pro obiekt sudovoi ekonomichnoi ekspertyzy [On the issue of the object forensic economics]. *Aktualni pytannia standartyzatsii sudovo-ekspertnoho zabezpechennia pravosuddia v Ukraini. Perspektyvy rozvytku* : mat-ly mizhnar. nauk.-prakt. konf., prysviach. 105-rich. sudov. ekspert. v Ukr. ta 95-rich.

z dnia narodzh. akad. M. Ya. Sehaia. (Kyiv, 04—05.07.2018). Kyiv [in Ukrainian].

Volkova, I. A. (2009). *Sudovo-bukhhalterska ekspertyza* [Forensic accounting] : navch. posib. Kyiv [in Ukrainian].

Yevdokimenko, S. V. (2015). Sudovo-ekonomichna ekspertyza u protydii pravoporushenniam u bankivskii sferi [Forensic and economic expertise in combating violations in the banking sector]. *Pravo i Bezpeka*. № 4. URL: https://nbuv.gov.ua/UJRN/Pib_2015_4_17 [in Ukrainian].

Zviagin, S. A. (2009). *Razvitie metodologii i metodiki bukhgalterskoi ehkspertizy* [Development of methodology and methods of forensic accounting] : dis. ... d-ra ehkon. nauk. Voronezh [in Russian].

Ivankov, V. (2022). Principles of forensic economics as a theoretical basis for its conducting. *Theory and Practice of Forensic Science and Criminalistics.* Issue 3 (25). P. 138—153. DOI: 10.32353/khrife.1.2022.09.

International support during the war

The Russian attack on Ukraine destroys not only human life and social infrastructure, but also it damages science: kills scientists, crashes institutions and laboratories, breaks established ties and ordinary procedures, ruins ideas and plans, deprives the very ability to work. Funding for research is lacking even where laboratories and librarians remain. The war is also a confrontation of intelligences. Side by side with the army and diplomacy, the science is able to resist hybrid threats and cyber-attacks from the Russian Federation.

Despite new challenges, science remains the driving force of human progress. Since the beginning of the war, many scientists were forced to leave their places of permanent residence in order to secure their lives and the lives of their relatives. The enemy destroyed and damaged scientific and educational institutions, equipment and facilities which also negatively affected the results of scientific activity. Despite the difficulties, Ukrainian scientists actively support the state not only in the work of the volunteer movement and personally in the ranks of the Armed Forces, but also on the scientific front: they continue the necessary research, work on developments in the field of defense and weapons.

Employees of National Scientific Center «Hon. Prof. M. S. Bokarius Forensic Science Institute» despite the racist invasion and difficult situation they found themselves from the first hours, continue their expert, research and educational activities.

The Center has always actively conducted international cooperation, and in these hard times foreign partners did not remain indifferent, because the unity is important in the

scientific community: to the address of National Scientific Center «Hon. Prof. M. S. Bokarius Forensic Science Institute» received letters of support and condolences from international partners — from Great Britain, Montenegro, Latvia, Lithuania, Poland, Armenia, Moldova and other countries.

In this hour of calamity for Ukraine, it is indicative that the international scientific community always helps domestic scientists as full members of it, as an integral part of it (in particular, forensic expert institutions of Ukraine, therefore and NSC «Hon. Prof. M. S. Bokarius FSI»: supports forensic experts who went abroad due to Russian aggression, sends humanitarian aid, transfers money, etc.

The cruelty of Russian barbarians horrified the entire scientific world. The European Network of Forensic Science Institutes (hereinafter referred to as *ENFSI*) was also not left out: on the official website, the *ENFSI* Council addressed the Scientific Forensic Expert Society and noted that (despite the fundamentally apolitical nature of this organization) it has taken the necessary measures to suspend cooperation with two Russian institutes on at all levels. Subsequently, due to the exclusion of the Russian Federation from the Council of Europe, the Russian institutes in Moscow and St. Petersburg were also deprived of ENFSI membership. The *ENFSI* Council considers this an affective and acceptable way to demonstrate the position of the entire association of forensic expert institutions in Europe, condemning in this way the Russian aggression against Ukraine.

For its part, the Ministry of Justice of Ukraine, which includes in its system of institutions the NSC «Hon. Prof. M. S. Bokarius FSI», uses all its resources to disseminate at the international level the urgent problems of forensic expertise that arose as a result of the war. The list of activities that took place under the auspices of the Ministry of Justice of Ukraine, already during the military aggression of the Russian fascists, includes consultations and working meetings, conferences and round tables, etc.

In particular, the Minister of Justice of Ukraine ***Denys Maliuska*** (under the program of a working visit) took part in the meeting of the international group of ministers of Justice in the Netherlands, initiated by Great Britain to deepen cooperation in the field of criminal Justice.

During the meeting, the ministers exchanged views and agreed on steps towards holding the Russian Federation accountable for numerous violations of international law

caused by its unprovoked aggression against Ukraine. The participants paid special attention to the opening of national criminal proceedings, the creation of a joint investigative team, as well as the expansion of capabilities of the International Criminal Court, whose Prosecutor officially began an investigation into the situation in Ukraine based on the appeal of the 41st state, a member of the Rome Statute.

The ministers emphasized that war crimes and crimes against humanity committed by the Russian military in Ukraine must be punished according to the established norms of international law.

We thank colleagues and friends throughout the civilized world for showing solidarity with Ukrainian scientists at this tragic time, in particular, with National Scientific Center «Hon. Prof. M. S. Bokarius Forensic Science Institute»!

The Russian military offensive against Ukraine is an unprecedented violation of basic human rights, an encroachment on life, democracy, freedom of thought and belief.

Despite this, let's move towards victory together, let's jointly develop world science, strengthen international partnership ties!

The information was prepared by ***Kateryna Sylenok****, a researcher of NSC «Hon. Prof. M. S. Bokarius FSI»*

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