

Forensic Examination and Criminalistics in Investigating War Crimes: European and Ukrainian Experiences

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ABSTRACT

The rising prevalence of war crimes, particularly in Ukraine, highlights the urgent need for robust forensic investigations to uphold justice and accountability in conflict zones. This study addresses the challenges in investigating war crimes, focusing on integrating effective forensic and criminalistics practices into Ukraine's framework. The research aims to summarize best practices in forensic science by drawing on the experiences of European countries and their application in Ukraine. A structural-functional approach was employed, utilizing qualitative data from case studies, legal documents, and forensic reports. Comparative analysis of methods used in Ukraine and Europe highlights current investigative practices' successes and challenges. Key findings include the effectiveness of DNA analysis for victim identification, digital technologies for documenting crimes, and forensic methodologies in evidence collection and analysis. The study concludes that forensic science and criminalistics are indispensable in war crime investigations, emphasizing the adoption of innovative techniques to improve justice delivery. Integrating advanced forensic practices into Ukraine's investigative processes can enhance accountability and contribute to international standards in war crime investigations.

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1. Introduction

The modern world is witnessing an increase in the number of armed conflicts accompanied by numerous war crimes. Ukraine is one of the countries directly affected by the hostilities, and the experience of other European countries in investigating such crimes is highly relevant for effective justice. The application of methods and technologies of forensic examination and criminalistics used in European countries can significantly increase the effectiveness of

criminal justice authorities in investigating war crimes in Ukraine committed by the Russian military against civilians. This includes using the latest technology, innovative methods of evidence collection, and expert training. The investigation of war crimes is aimed at protecting the rights of victims of the war in Ukraine and ensuring justice. Advanced forensic and investigative techniques help establish facts more accurately and bring perpetrators to justice, essential to restoring justice and trust in the legal system. Criminalistic methods provide a detailed reconstruction of events and the collection of evidence of war crimes necessary for an effective trial. This is especially true in the context of the military conflict between Ukraine and Russia, where it is important to establish the truth and bring the perpetrators to justice. The European experience can be used to improve cooperation with international organizations and experts, facilitating the exchange of knowledge and resources. This helps Ukraine implement international standards in investigating war crimes more effectively. Thus, the relevance of studying this topic is due to the need to improve the effectiveness of justice, protect human rights, improve the national legal system, and fulfill Ukraine's international obligations in investigating war crimes committed by Russia.

Coco, M. Maistrenko, et al., V. Y. Shepitko, and M. V. Shepitko addressed this topic and noted that war crimes are among the most serious international crimes, and investigating such crimes requires specialized forensic and criminalistics methods.¹ According to the findings of A. Coco, modern technologies, and scientific methods can be used to collect and analyze evidence to bring the perpetrators to justice. According to the results of V. Y. Shepitko and M. V. Shepitko, forensic examination and criminalistics are indispensable in investigating war crimes. They help ensure justice, establish the truth, and bring those responsible to justice. As M. Maistrenko et al. noted, investigating war crimes is an exceptionally complex process that requires an interdisciplinary approach, international cooperation, and state-of-the-art technology.

It is an effective investigation that can help to establish justice, restore peace, and prevent future conflicts. Investigations must be independent and impartial, which can be difficult to achieve in internal or international conflicts. It is necessary to ensure transparency and compliance with legal standards at all stages of the investigation. Having studied the role of international cooperation in the field of forensics in the investigation of war crimes, G. Calcara, and S. Maruf noted that it plays an important role in ensuring the successful detection and prosecution of war crimes.²³ Following G. Calcara, this includes exchanging information between countries, conducting joint investigations, conducting examinations, and other forms

¹ Antonio Coco, 'The Universal Duty to Establish Jurisdiction over, and Investigate, Crimes Against Humanity: Preliminary Remarks on Draft Articles 7, 8, 9 and 11 by the International Law Commission', *Journal of International Criminal Justice*, 16.4 (2018), 751–74. <https://doi.org/10.1093/jicj/mqy042>; Maria Maistrenko, Kira Gorelkina, and Yevdokiia Buzhdyhanchuk, 'International and National Mechanisms for the Protection of the Rights of Victims of Armed Conflict in Eastern Ukraine', *Novum Jus*, (2021), 17–41. <https://doi.org/10.14718/NovumJus.2021.15.E.2>; Mykhaylo Shepitko, and Valery Shepitko, 'The Role of Forensic Science and Forensic Examination in International Cooperation in the Investigation of Crimes', *Journal of the National Academy of Legal Sciences of Ukraine*, 28.1 (2021), 179–86 <https://doi.org/10.37635/jnalsu>.

² Giulio Calcara, 'Balancing International Police Cooperation: INTERPOL and the Undesirable Trade-off Between Rights of Individuals and Global Security', *Liverpool Law Review*, 42.2 (2021), 111–42. <https://doi.org/10.1007/s10991-020-09266-9>.

³ Shah Maruf, 'Environmental Damage in Ukraine as Environmental War Crime under the Rome Statute: The Kakhovka Dam Breach in Context', *Journal of International Criminal Justice*, 22.1 (2024), 99–126. <https://doi.org/10.1093/jicj/mqae004>.

of cooperation. International treaties relating to forensic activities define the procedure for international cooperation and interaction between law enforcement agencies of different countries in the field of war crimes investigation. An important aspect is also to ensure the preservation and reliability of evidence in international investigations for further use in court proceedings, according to the findings of A. Florczak et al., international organizations such as the International Criminal Court (ICC), the United Nations (UN), and the International Committee of the Red Cross play an important role in war crimes investigations, providing support and resources, as well as coordinating the efforts of different countries and organizations. Following S. Maruf, war crimes are investigated in international humanitarian law, which includes the Geneva Conventions and their additional protocols, the Rome Statute of the International Criminal Court, and other international legal acts. Investigating war crimes requires in-depth knowledge of these documents and the ability to apply them in practice.⁴

Modern military conflicts require continuous improvement of forensic technologies and expertise to investigate war crimes effectively. One of the most promising innovations is using cyber forensics to detect and analyze digital traces in military operations; Yu. G. Zmiyevska, an important technological innovation, uses modern means and capabilities of forensic molecular genetic examination to identify victims of war crimes and generate evidence of such crimes. Other promising areas are the use and implementation of modern methods of forensic ballistics and forensic explosives to investigate rocket attacks and gunshot damage, and the use of the latest photo and video recording equipment, as well as the capabilities of aerial forensics to document war crimes objectively. Despite the growing interest in this topic, several issues remain unexplored or require further study. In addition, it is necessary to investigate the psychological aspects of the problem, as well as methods of psychological support for witnesses and victims who testify in war crimes cases.

Therefore, given the above, the study aims to address the role of forensic examination and criminalistics in investigating war crimes and to compare European and Ukrainian experiences. Goals include the Definition of the basic concepts, classifications, and latest methods used in forensic science and criminalistics in the investigation of war crimes, analysis of European practices and standards in criminalistics and criminal investigations, and development of recommendations for improving the process of investigating war crimes in Ukraine.

2. Research Method

This study employed a structural and functional approach to examine the concept of "war crimes" and its interpretations in modern international law. It analyzed international cooperation in forensic examinations and criminalistics during war crime investigations, highlighting advanced forensic methods for evidence collection, analysis, and the use of specialized knowledge. The study also explored the challenges of applying forensic techniques in military conflicts and assessed the role of international tribunals, particularly the ICC, in prosecuting war crimes. Historical and contemporary applications of forensic science were reviewed, focusing on the Srebrenica massacre (1995), the Kosovo conflict (1998–1999), and documented war crimes during the Russian invasion of Ukraine as of June 2024. Legal

⁴ Yordan Gunawan, Ghyats Amri Wibowo, and Mohammad Hazyar Arumbinang, 'Foreign Fighters in the Ukrainian Armed Conflict: An International Humanitarian Law Perspective', *Volksgeist: Jurnal Ilmu Hukum Dan Konstitusi*, 6.2 (2023), 145–57. <https://doi.org/10.24090/volksgeist.v6i2.9315>.

frameworks in Ukraine, including the Criminal Procedure Code and related laws, were analyzed alongside modern techniques like DNA analysis, digital forensics, and ammunition residue studies used to investigate and document war crimes. The study proposed recommendations to enhance the effectiveness of forensic science and criminalistics in war crime investigations.

3. Result and Discussion

3.1. Concept and Definition of War Crimes

In international treaties, selected as sources of international criminal law, the term “war crimes” is not conceptually defined. Nevertheless, it is necessary to note that war crimes are, from time to time, described in the legal instruments of modern international law as a consequence of the violation of the basic values and standards of international law applicable during armed conflict.⁵ Attacks on civilians and energy infrastructure, intentional killings, unlawful detention, torture, rape, and other forms of sexual violence, as well as the unauthorized transfer and displacement of minors, are considered war crimes. Although it may be difficult to establish the reality of this type of war crime, environmental destruction during armed conflict is also considered a war crime.⁶

To investigate such criminal offenses and bring the perpetrators to justice, it is necessary to conduct certain operational and investigative actions and collect evidence, a major problem during active hostilities and the physical impossibility of gathering this evidence in uncontrolled regions. These criminal offenses require specific operational and investigative actions to collect evidence and bring the perpetrators to justice. Evidence of a crime committed in the temporarily occupied territory may come from various sources, including information obtained during covert investigative (search) actions, from electronic information systems and transport telecommunication networks (for example, by tapping the phones of the persons involved and accessing their email accounts); information obtained from the mass media and the global Internet; and information obtained from interviews with witnesses or victims who managed to escape from the territory controlled by Ukraine.⁷ If certain settlements have already been liberated from the occupiers, potential sources of evidence may include inspection of crime scenes, interrogation of witnesses and victims, conducting investigative tests, and gathering data from undercover investigations. Nevertheless, investigating war crimes will be difficult, as searching for evidence and verifying the incident site can take a long time, making it difficult to collect information and conduct additional research.

⁵ Yolanda Damai Raharja, and Wreda Danang Widoyoko, ‘The characteristics of war crimes under international law: A case study of the Russia and Ukraine war’, *Journal of Court and Justice*, 2.3 (2023), 41–53. <https://doi.org/10.56943/jcj.v2i3.391>.

⁶ Yordan Gunawan and others, ‘Journalist Protection on the Battlefield Under the International Humanitarian Law: Russia-Ukraine War’, *Jurnal Hukum Unissula*, 39.1 (2023), 1–11. <https://doi.org/10.26532/jh.v39i1.24685>.

⁷ Olena Verhogyad-Gerasymenko, Oksana Kaplina, Anush Tumanyants, and Iryna Krytska, ‘Application of artificial intelligence systems in criminal procedure: Key areas, basic legal principles and problems of correlation with fundamental human rights’, *Access to Justice in Eastern Europe*, 6.3 (2023), 147–66 <https://doi.org/10.33327/AJEE-18-6.3-a000314>

3.2. Forensic Examination and Criminalistics in War Crime Investigations

Forensic examination and criminalistics are integral elements of the war crimes investigation process. They assist in collecting, analyzing, and interpreting the evidence needed to establish the truth and bring perpetrators to justice. In Ukraine, the use of forensic science and criminalistics in the investigation of crimes is regulated by several regulations, including the Criminal Procedure Code of Ukraine – which establishes general provisions, procedures, and procedures for conducting criminal proceedings, including the use of forensic methods for collecting and analyzing evidence), Law of Ukraine No. 4038-XII on Forensic Examination– regulates the procedure for the appointment and conduct of forensic examinations, the activities of expert institutions, and the rights and obligations of forensic experts); Instruction on the appointment and conduct of forensic examinations and expert studies, Law of Ukraine No. 2135-XII “On Operational Investigative Activity” – defines the legal basis for operational investigative activity, including the use of forensic methods and technical means in the investigation of crimes), Orders of the Ministry of Internal Affairs of Ukraine, which establish specific rules and procedures for the use of forensic methods in the investigation of crimes, inspection of crime scenes, seizure and storage of evidence; State standards and regulations on forensic science, including guidelines and standards for conducting forensic investigations, using technical means, ensuring the quality and reliability of expert opinions.⁸⁹¹⁰ In Ukraine, the legislative framework, including the Criminal Procedure Code, the Law on Forensic Examination, and the Law on Operational Investigative Activity, provides a substantial basis for conducting forensic analysis and criminalistics during investigations and prosecutions.

While these regulations are generally sufficient to guide proceedings, their practical effectiveness depends on consistent enforcement, adequate resources, and proper coordination among relevant authorities. As a result, continued legal refinements and capacity-building efforts remain essential to ensure that these laws can be fully invoked in complex or large-scale cases, thereby facilitating comprehensive and reliable outcomes.

The European experience in this area provides valuable lessons and methods that can be useful for Ukraine, especially in current conflicts. Forensic examination can accurately establish the circumstances of a crime using methods of analyzing physical evidence, such as DNA samples, traces of weapons, explosives, etc. Forensic techniques, including ballistics, trace evidence, and fingerprinting, help identify individuals involved in crimes and ensure a fair trial by protecting the rights of both victims and suspects. Several European countries, such as Germany, have invoked universal jurisdiction and relied on methods consistent with Article 17 of the Rome Statute (on complementarity) to investigate alleged war crimes. In these cases, authorities collected and analyzed evidence by the ICC’s Elements of Crimes (Articles 8 and 9) and the ICC Rules of Procedure and Evidence, thereby mirroring the chain-of-custody and evidentiary standards necessary for war crimes prosecution. This approach, which has resulted in successful prosecutions before domestic courts, highlights how the same forensic methods and criminalistics, when properly regulated and supported, can be adopted by

⁸ Oleksandr Drozdov and others, ‘The Standard of Proof “beyond a Reasonable Doubt” in Criminal Proceedings of Ukraine in the Context of the ECHR Case-Law’, *Amazonia Investiga*, 10.46 SE-Articles (2021), 281–89. <https://doi.org/10.34069/AI/2021.46.10.28>.

⁹ Sybirna R. and Havts O, ‘Peculiarities of Preparation of Certain Types of Forensic Examinations’, *Bulletin of Lviv Polytechnic National University. Series: Legal Sciences*, 11.2 (2024), 128–39. <https://doi.org/10.23939/law2024.42.128>.

¹⁰ I I Yatsenko, ‘Forensic Examination as an Object of Administrative and Legal Regulation of International Cooperation’, *Law and Safety*, 78.3, (2020). <https://doi.org/10.32631/pb.2020.3.12>.

Ukraine to achieve justice. Cooperation with international organizations, improvement of the legal framework, and modernization of the technical base remain key steps for enhancing the effectiveness of war crimes investigations, as they align with the principles enshrined in the Rome Statute and embody best practices demonstrated by states that have exercised domestic jurisdiction under the complementarity principle.¹¹

Criminalistics uses scientific methods and techniques to collect and examine evidence at crime scenes and during investigations. This may include crime scene examination (fixing the scene, identifying and collecting physical evidence such as corpses, weapons, ammunition, explosives, fingerprints, DNA, etc.); photography and video recording (documenting the scene and evidence); forensic ballistics (examining weapons and ammunition, determining the trajectory of bullets and other projectiles); forensic explosives (examination of explosive devices and explosives, determination of the type of explosive, method of detonation and origin); forensic medicine (examination of corpses and injuries, determination of the cause of death, time of death, mechanism of injury); fingerprinting (examination of fingerprints to identify individuals); genetic examination (examination of DNA to identify individuals, determine their origin, establish family relationships).¹²

The forensic examination uses specialized knowledge and techniques to examine evidence obtained during an investigation, which may include the examination of weapons and ammunition (determination of the type of weapon, ammunition, their suitability for firing, determination of the correspondence of firearms and ammunition to the crime scene); examination of explosive devices and explosives (determination of the type of explosive, method of detonation, the origin of explosives); forensic examination (examination of corpses and injuries, determination of the cause of death, time of death, mechanism of injury); genetic examination: DNA testing to identify individuals, determine their origin, and establish family ties); forensic chemical examination (examination of physical evidence, such as poisons, drugs, and explosives, to determine their composition, origin, and use); forensic psychological examination (examination of the mental state of persons suspected of committing a crime or victims, assessment of their ability to perceive and remember events).¹³

The peculiarities of forensic examination and criminalistics in military conflicts are the complexity and danger of the work of experts and forensic scientists due to the military context.¹⁴ They should address the specifics of military operations, the possibility of interference by parties to the conflict in the work of experts, and the preservation and documentation of evidence in a military environment. It is also necessary to account for international standards and conventions governing the use of forensic science and criminalistics in military conflicts to ensure the objectivity and integrity of evidence. In

¹¹ Andriy Shulha, Andrii Tkach, Yevheniia Murzo, Maryna Horodetska, and Tetiana Sokur, 'Forensic Information Sources During the Investigation of War Crimes', *Revista Amazonia Investiga*, 12.71 (2023), 103–16. <https://doi.org/10.34069/ai/2023.71.11.9>

¹² Hans H. de Boer and others, 'The Logic of Forensic Pathology Opinion', *International Journal of Legal Medicine*, 136.4 (2022), 1027–36. <https://doi.org/10.1007/s00414-021-02754-1>.

¹³ Helen Page, Graeme Horsman, Anna Sarna, and Julianne Foster, 'A Review of Quality Procedures In The UK Forensic Sciences: What Can the Field of Digital Forensics Learn?', *Science and Justice*, 59.1 (2019), 83–92. <https://doi.org/10.1016/j.scijus.2018.09.006>.

¹⁴ Mehdi Benhassine and others, 'Advancing Military Medical Planning in Large Scale Combat Operations: Insights from Computer Simulation and Experimentation in NATO's Vigorous Warrior Exercise 2024', *Military Medicine*, 189 (2024), 456–64. <https://doi.org/10.1093/milmed/usae152>.

addition, experts and forensic scientists must have special training and experience to conduct efficient operations in the context of armed conflict and successfully investigate war crimes.¹⁵

Practical aspects of using criminalistics in investigating war crimes include forensic examinations of various types of evidence, including genetic, ballistic, fingerprinting, etc.¹⁶ Another important aspect is the involvement of forensic experts in analyzing the traces found at the crime scene. Investigating war crimes also involves using special forensic techniques to collect and analyze data to establish the circumstances of the crime, identify suspects, and gather evidence of their guilt. Forensic examination plays a key role in detecting and investigating war crimes, ensuring objectivity and scientific evidence of violations of international humanitarian law.¹⁷

Ukraine has a long history of using forensic examination and criminalistics in the investigation of war crimes. Since the first wars, forensic science has become an integral part of war crimes investigations. Professional Forensic examinations used their knowledge and methods to collect evidence during the war.¹⁸ This practice continued during the Second World War when forensic science was an integral part of the investigation of crimes against humanity and war crimes. A historical overview determined how forensic examination has been continuously improving in the context of military conflicts to ensure justice and accountability for crimes.¹⁹

The use of forensic examination in the investigation of war crimes plays an important role in clarifying the circumstances of the crime. The examination establishes technical details and circumstances related to the crime and examines weapons, ballistics, radiation traces, and other materials that can be used as evidence in criminal proceedings. In addition, forensic examination can identify the person or persons responsible for a war crime, making it an integral part of the investigation of such crimes.²⁰

International Humanitarian Law lays down fundamental principles designed to protect individuals and regulate conduct in armed conflict, yet it does not provide specific procedures for forensic examination and criminalistics. Instead, it generally mandates that serious breaches be investigated and prosecuted, leaving the practical details to states and international bodies. Beyond traditional treaty-based sources, other legal frameworks, including soft law instruments such as the Minnesota Protocol on the Investigation of Potentially Unlawful Death and the UN Manual on the Effective Prevention and Investigation

¹⁵ Mariia Hryha, and Andrii Vozniuk, 'Topical Issues of Forensic Medical Examination In the Investigation of War Crimes', *Naukovij Visnik Nacional'noi Akademii Vnutrišnih Sprav*, 28.2 (2023), 9–18 <http://dx.doi.org/10.56215/naia-herald/2.2023.09>.

¹⁶ Petro Petrovskyy, Olha Fedorchak, Bohdan Shevchuk, Halyna Dzyana, and Ihor Drobot, 'Institutional and socio-psychological determinants of the delinquency of ruscism in the war against Ukraine', *Social and Legal Studies*, 7.2 (2024), 104–18 <https://doi.org/10.32518/sals2.2024.104>

¹⁷ Lawrence J. Trautman, and Maia McFarlin, 'Putin, Russia and Ukraine: International human rights violations, war crimes, & future implications', *SSRN Electronic Journal*, 3 (2023) <https://doi.org/https://doi.org/10.2139/ssrn.4393282>

¹⁸ Yordan Gunawan and Muhammad Ervizar Rizqy Pane, 'Responsibility for Excessive Infrastructure Damage in Attacks: Analyzing Russia's Attack in Ukraine', *PETITA: Jurnal Kajian Ilmu Hukum Dan Syariah*, 9.1 (2024). <https://doi.org/10.22373/petita.v9i1.213>.

¹⁹ Shrouk Mahmoud Saleh, 'The War Between Russia And Ukraine: Crimes Against Humanity Under The Rome Statute of The International Criminal Court', *SCIREA Journal of Sociology*, 7.2 (2023), 119–32 <https://doi.org/10.54647/sociology84889>.

²⁰ Yurii Filipov, 'Technical And Forensic Support For The Investigation Of War Crimes: Concept, Purpose, Individual Areas Of Development', *Ūridičnij Časopis Nacional'noi Akademii Vnutrišnih Sprav*, 12.4 (2022), 72–83 <https://doi.org/10.56215/04221204.72>

of Extra-Legal, Arbitrary, and Summary Executions, can fill the gap by outlining best practices on evidence collection and chain-of-custody procedures. These instruments are not legally binding in the same manner as the Rome Statute or Geneva Conventions, but they offer detailed guidance for practitioners that can help foster consistency across different jurisdictions.

In the absence of uniform standards under International Humanitarian Law, discrepancies have emerged among countries investigating war crimes. Each state may apply divergent procedural rules, forensic protocols, and evidentiary requirements, which can create challenges when comparing the efficacy of forensic examination and criminalistics across multiple conflict zones. Nevertheless, many countries adopt or adapt broad international guidelines, preserving a core set of forensic principles that facilitate cooperation and mutual legal assistance. Comparing the experiences of states that have investigated war crimes, such as those in the former Yugoslavia or those relying on universal jurisdiction, underscores the value of a shared methodological foundation and the potential friction when legal systems with different procedural norms attempt to coordinate complex cross-border investigations.

Although the comparative method highlights valuable lessons, it can also reveal gaps or inconsistencies that arise from cultural, institutional, or resource-based differences. These discrepancies may affect how evidence is gathered, analyzed, and admitted in court. From a theoretical perspective, transitional justice and deterrence theory help explain how robust forensic processes can restore public trust and discourage future atrocities. The principle of complementarity, as embodied in the Rome Statute, provides additional context for understanding how domestic jurisdictions and the International Criminal Court can collaborate or supplement each other's efforts in prosecuting war crimes. The successful use of forensic examination and criminalistics relies on technical accuracy and how deeply a state's legal and institutional frameworks reflect international standards and obligations.

3.3. The Russian Invasion of Ukraine: Impact on Crime and Investigations

The Russian invasion and the imposition of martial law had a profound impact on the dynamics of crime in Ukraine; throughout the conflict, modifications and transformations of criminal activity took place. After the Russian invasion and the outbreak of war in Ukraine, new categories of crimes that either did not exist before or existed in limited numbers appeared. The Office of the Prosecutor General has identified the most common crimes committed during the full-scale Russian invasion as of 23 June 2024 (Table 1).

Table 1: Crimes committed during the period of the full-scale invasion of Russia

Category	Registered quantity
	134565, of which:
	Violation of the laws and customs of war (Article 438 of the Criminal Code of Ukraine) – 130503;
Crimes of aggression and war crimes	Planning, preparation or initiation and conduct of aggressive war (Article 437 of the CCU) – 105;
	Propaganda of war (Article 436 of the CCU) – 79;
	Others – 3878;

Offences against national security	17835, of which:
	Encroachment on the territorial integrity and inviolability of Ukraine (Article 110 of the CCU) – 3211; High treason (Article 111 of the CCU) – 3393; Collaboration activities (Article 111-1 of the CCU) – 8241; Aiding the aggressor state (Article 111-2 of the CCU) – 1269; Subversion (Article 113 of the CCU) – 139; Others – 1582;
The main case of Russian aggression	698 suspects are representatives of the military and political leadership of the Russian Federation (military commanders, officials, ministers, deputies, heads of law enforcement agencies, etc.)
Crimes against children *without full consideration of the active hostilities	551 children died 1392 children injured

Source: D. Azarov et al.²¹

The Ukrainian Helsinki Human Rights Union is still documenting the crimes committed by Russia against Ukraine. As of May 2024, 2,171 more episodes have occurred since the start of the full-scale invasion, for a total of 52,144. Approximately 25% of officially registered war crimes involve violations of civilian rights or deaths. In May 2024, the following results showed the largest increase in documented war crimes (Figure 1).

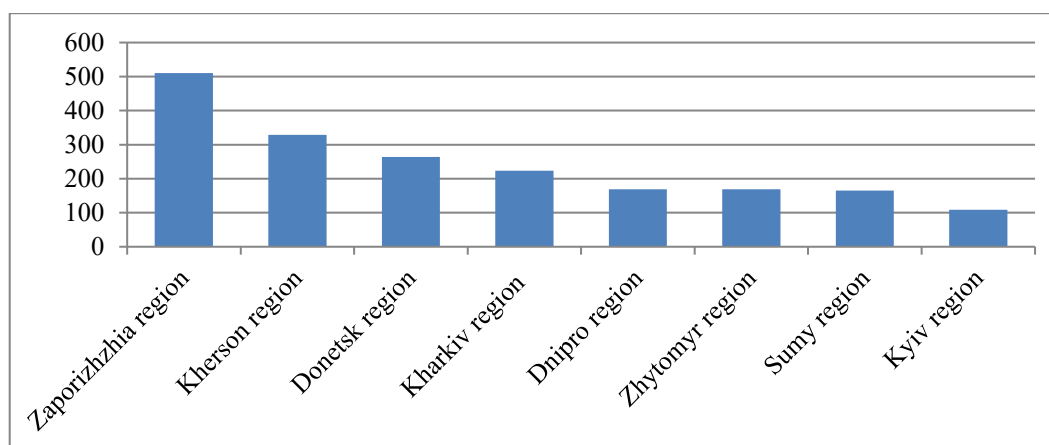


Figure 1. Number of documented war crimes as of May 2024

Source: B. Hamarowski and M. Lompe ²²

The changes in crime in Ukraine during the conflict significantly impacted forensic science priorities, expertise development, and employment under martial law. The main goal of criminology is to develop and implement strategies, tactics, and procedures that allow the collection, analysis, and use of evidence in the context of modern warfare and international

²¹ Denys Azarov and others, 'Understanding Russia's Actions in Ukraine as the Crime of Genocide', *Journal of International Criminal Justice*, 21.2 (2023), 233–64. <https://doi.org/10.1093/jicj/mqad018>.

²² Bartosz Hamarowski and Maria Lompe, "'Digital Witnesses to the Crime: Visual Representation of the Bucha Massacre across Social Media Platforms'", *Media, War & Conflict*, 17.4 (2024), 578–602. <https://doi.org/10.1177/17506352241243302>.

threats. In these circumstances, it is urgent to consider strengthening the role of forensics in digitalization and combat situations.

One example of the successful use of forensic examination and criminalistics in the investigation of war crimes in Ukraine concerns the establishment of the circumstances of the shelling of civilian settlements. Forensic examination established the exact location of the enemy's firing positions and fire direction. Forensic investigations can determine the nature and caliber of the weapon used, which is an important detail for further investigation. Out of 252 incidents, detailed information was received on 62 incidents in the Luhansk region, including Alchevsk, Kramatorsk, and Lysychansk, which were in hostilities at the time of the attack and where large-caliber artillery, small arms, and/or multiple launch rocket systems were used against these settlements. This information was obtained from reports, interviews, videos, photographs, intercepted communications, telecommunications data, weapon trajectories, and the remains of occupation units. The methods and procedures used in these forensic investigations were developed and field-tested in response to the urgent need to investigate civilian casualties as quickly as possible in a highly politicized environment where there was direct access to the scene of the incident.²³

Another important example of the successful application of forensic science and forensics in the investigation of war crimes in Ukraine is the effective use of biological methods to identify deceased persons as a result of hostilities. For instance, the use of DNA research identified a person who died as a result of shelling in the east of the country. During the armed conflict in eastern Ukraine, several identifications of deceased servicemen and civilians were carried out as part of humanitarian operations. One of these cases occurred during the identification of victims of the Ilovaisk battle in August 2014. The bodies of many of the victims were so damaged that DNA analysis was the only way to identify them. DNA samples were collected from the relatives of the missing persons, and a comprehensive analysis of the DNA samples of the deceased was carried out, which identified many of them for subsequent transfer of their bodies to their families for burial. Forensic experts also use methods to document traces of war crimes, including the study of explosive residues and weapons, which establishes the circumstances of the crimes and the perpetrators. These examples demonstrate the importance of the integrated use of forensic science and criminalistics in the investigation of war crimes in Ukraine. These examples illustrate the importance and effectiveness of forensic examination and investigation in investigating war crimes.

Under the complementarity principle, Ukraine can and should conduct its domestic investigations to bring perpetrators of war crimes to justice, thereby strengthening the rule of law within its legal framework. At the same time, any proceedings conducted in Ukraine may support international processes, such as the ICC arrest warrant, by supplying verifiable evidence gleaned from forensic investigations. In this manner, Ukraine not only fulfills its sovereign responsibility to prosecute serious crimes but also cooperates with the ICC through shared or complementary mechanisms, ensuring that, whether in domestic courts or at the international level, justice for victims of war crimes remains a priority.

3.4. International Framework and Future Prospects

The practical experience of using forensic examination and criminalistics in Ukraine demonstrates their critical role in the investigation of war crimes. Despite numerous

²³ Christopher M. Jackson, 'Cross-Border Clientelism, Commitment, and the Protraction of Irredentist Conflicts', *European Journal of International Security*, 2 (2024), 1–24. <https://doi.org/10.1017/eis.2024.48>.

challenges, Ukraine is actively improving domestic investigative methods, drawing on international experience and modern technology. Further development in this area is key to ensuring justice and protecting the rights of victims of war crimes.²⁴

The current state of affairs in Ukraine requires the criminalistics to improve, create, and implement a system of forensic methods for investigating crimes against the foundations of national security of Ukraine; war crimes committed in the country by Russia; crimes against peace, human security and international law; crimes related to the misuse of free or charitable aid, humanitarian assistance or donations; and illegal crossing of the state border of Ukraine, among other crimes. The widespread use of information and computer technologies ensures the efficiency and effectiveness of the judicial process and the further growth of the criminal investigation process's algorithm mission.²⁵

The organizational and legal framework for forensic examination and criminalistics in Europe is based on the legislation of each country, as well as international standards, in particular, the European Convention for the Protection of Human Rights and Fundamental Freedoms. In many European countries, forensic science and criminalistics operate within the national police or the Ministry of Justice. The legislation also defines the rights and obligations of experts, the procedures for conducting forensic investigations, and interaction with law enforcement agencies and judicial institutions.²⁶

The legal framework for forensic examination and criminalistics in Europe includes several legal acts that regulate the conduct of examinations and the use of forensic methods to investigate war crimes.²⁷ These are laws, regulations, directives, and other acts that define the competence and procedure of forensic experts and criminalists, as well as the rules for preserving, collecting, and analyzing evidence in criminal proceedings. The European experience also includes international agreements signed by the member states of the European Union and other European countries aimed at cooperation in forensic science and criminalistics in investigating war crimes. The massacre of more than 8,000 Bosnian Muslims in Srebrenica in July 1995 was one of the largest war crimes in Europe after World War II. The main forensic methods used in the investigation of this crime are geophysical methods (the use of radar to detect mass graves), DNA analysis (identification of victims through DNA tests, which allowed the return of remains to relatives and confirmation of the scale of the crime), forensic anthropology (study of bone remains to determine the cause of death and circumstances of the murder).

The greatest loss of human life during the breakup of Yugoslavia occurred during the fall of Srebrenica in July 1995. More than 200.000 people died in the ground war that led to the break-up of Yugoslavia, with the majority of the deaths occurring in Croatia, Bosnia and

²⁴ Andrejs Vilks, Aldona Kipane, and Anatolijs Krivins, 'Preventing International Threats in the Context of Improving the Legal Framework For National and Regional Security', *Social and Legal Studies*, 7.1 (2024), 97–105. <https://doi.org/10.32518/sals1.2024.97>

²⁵ Oksana Dufeniuk, 'Investigation Of War Crimes In Ukraine: Challenges, Standards, Innovations', *Baltic Journal of Legal and Social Sciences*, 1 (2022), 46–56. <https://doi.org/10.30525/2592-8813-2022-1-6>

²⁶ Yan Qiao, 'Assessing War Crimes Accountability Through Just War Theory : A Comparative Legal Analysis Of Russia-Ukraine Conflict', *Proceedings of the 2nd International Conference on Global Politics and Socio-Humanities*, 0 (2024), 63–69 <https://doi.org/10.54254/2753-7048/70/20241010>.

²⁷ Viktoriia V. Haltsova, Sergiy A. Kharytonov, Oleksandr M. Khramtsov, Oleksandr O. Zhytnyi, and Andrii A. Vasyliiev, 'Criminal Law As A Means Of Protecting Human Rights And Freedoms In The Modern World', *Journal of the National Academy of Legal Sciences of Ukraine*, 28.3 (2021), 248–56 [https://doi.org/10.37635/jnalsu.28\(3\).2021.248-256](https://doi.org/10.37635/jnalsu.28(3).2021.248-256)

Herzegovina between 1991 and 1995, and Kosovo in 1999. An additional 20.000-30.000 people remained missing after the end of hostilities. The high number of missing persons caused political controversy throughout the former Yugoslavia and served as a catalyst for instability in several newly formed countries. Many of these missing persons could not have been accurately identified without the use of sophisticated forensic procedures based on DNA analysis. Considering this, the world's most successful DNA-based identification method was created. In addition to advancing scientific understanding, identifying thousands of missing persons has catalyzed uniting disparate groups around a common goal. It also demonstrated the ability of forensics to hold individuals and countries accountable for their actions, serving as a model for future missions of a similar nature and contributing to the understanding of how forensics can be designed to prevent violence and genocide.²⁸

Numerous war crimes accompanied the war in Kosovo (1998-1999) on both sides of the conflict. The Federal Republic of Yugoslavia and the European Union (EU) had some freedom to intervene in the ethnic conflict in Kosovo. One action was the deployment of the EU-FET Finnish forensic team under EU leadership to investigate reports of mass graves in the region.²⁹ Different groups involved in the ethnic conflict have different explanations of events. Two statements were made: one claimed that armed men were injured during the shooting, while the other claimed that armed police killed civilians. As a result, EU-FET became involved in these investigations in addition to the original investigation. EU-FET's responsibility was to verify the objectivity of the autopsy.³⁰ During the full forensic autopsies carried out by EU-FET following Interpol and UN guidelines, standard forensic methods were used, namely forensic medical examination (examination of the bodies of the dead to determine the cause of death, including cases of executions and torture), forensic analysis of explosives (examination of explosion sites to determine the type of explosives used and their origin), digital forensics (analysis of electronic data and documents to identify evidence of planning and execution of war crimes).³¹

Examples from European practice demonstrate the importance of using modern forensic and criminalistics methods in the investigation of war crimes. Victim identification, crime scene analysis, DNA analysis, and other technologies help ensure justice and bring perpetrators to justice. This experience can be useful for other countries, including Ukraine, in investigating war crimes and protecting human rights. The importance of international cooperation in conducting forensic examinations and forensic investigations in war crimes cases cannot be underestimated. In war crimes with a global dimension, collaboration between countries in conducting forensic examinations and forensic investigations is of particular importance. Information exchange, joint operations, research, and the application of international standards are all essential for successful investigations and effective decision-making concerning war crimes.

²⁸ D. L. R. Tchobo, 'Potential International Crimes In Ukraine: Should Atrocities In Bucha Be Classified As Genocide, War Crimes, Or Crimes Against Humanity?', *Law and Safety*, 85.2 (2022), 13-20 <https://doi.org/10.32631/pb.2022.2.01>

²⁹ Ditor Haliti, Diana Swales, and Alan Robinson, 'Analysis of Skeletal Trauma on the Bodies Found in a Mass Grave', *International Journal of Legal Medicine*, 137.1 (2023), 157-67. <https://doi.org/10.1007/s00414-022-02806-0>.

³⁰ Oleksandr Sarnavskiy, 'Differentiation of Criminal Liability For War Crimes', *Legal Ukraine*, 6 (2020), 55-61. [https://doi.org/10.37749/2308-9636-2020-6\(210\)-7](https://doi.org/10.37749/2308-9636-2020-6(210)-7).

³¹ Aybeyan Selim, and İlker Ali, 'The Role of Digital Forensic Analysis in Modern Investigations', *Journal of Emerging Computer Technologies*, 4. December (2024), 1-5 <https://doi.org/10.57020/ject.1445625>

The issue of using digital technologies to improve the effectiveness of investigations of modern crimes, such as cybercrime and war crimes, is one of those that need to be addressed immediately. Other names, such as “computer forensics,” “electronic forensics,” and “forensics in computer systems,” also indicate this direction.³² Without the widespread application of innovative and fundamental knowledge in the field of digital forensics – a new branch of forensics that is currently developing dynamically and forming the theoretical and methodological foundations in this area of knowledge – forensics cannot continue to develop in the context of the information society, digitalization, and modern military realities. Currently, there are three main ways of developing digital forensics: the creation of digital forensics as a separate scientific field, the use of specialized knowledge when working with digital evidence, and forensic examinations, including technical and computer examinations.

As the practice described in open sources has shown, digital forensics methods play a crucial role in identifying, detecting, and investigating war crimes in a modern environment of full-scale aggression. The facts of mass killings and war crimes committed in the towns of Kyiv region between 27 February 2022 and 31 March 2022 were established using digital forensic techniques and data from available sources. After liberating Bucha, the Ukrainian Armed Forces found a significant number of civilian bodies on the streets. The Russian government has been promoting the narrative that this was an order and that the dead were disposed of after the liberation of the town following the release of video of these bodies. However, satellite imagery demonstrated that the bodies appeared during the Russian occupation. Mass funerals are an important topic to keep in mind in this scenario. Most of them are in temporarily occupied and inaccessible territories, so digital forensics, i.e. the study and comparison of satellite images, can be very helpful in locating the perpetrators. This was the case with the mass grave that took place near St Andrew's Church in Bucha, which was revealed by Maxar satellite imagery.³³

War crimes are prosecuted by international tribunals, such as the ICC, which tries the most serious crimes that pose a threat to global peace and security.³⁴ The day that the Statute of the International Criminal Court entered into force will go down in history as a landmark step towards strengthening the international criminal justice system, providing better protection from fear against crimes recognized by the international community as the most serious threats to peace and security. Given the urgent need for the international community to act and restore the appearance of deterrence, the ICC structure will provide the best mechanism for a swift and fair response.

The events in the former Yugoslavia, as well as in other countries around the world, provoked the international community to establish a permanent ICC responsible for convicting individuals accused of the most serious crimes of global concern, such as genocide, crimes against humanity, and war crimes. The Statute of the International Criminal Court was adopted in Rome on 17 July 1998 and entered into force on 11 April 2002. The intensive work to establish the International Criminal Court coincided with establishing the ad hoc

³² Fran Casino, Thomas K. Dasaklis, Georgios P. Spathoulas, Marios Anagnostopoulos, Amrita Ghosal, and István Bořoň, ‘Research trends, challenges, and emerging topics in digital forensics: A review of reviews’, *IEEE Access*, 10 (2022), 25464–25493. <https://doi.org/10.1109/ACCESS.2022.3154059>

³³ Viktor Shevchuk and others, ‘Criminalistic Support of Combating Iatrogenic Criminal Offenses: Information System Prospects’, *Social and Legal Studies*, 6.4 (2023), 208–16. <https://doi.org/10.32518/sals4.2023.208>.

³⁴ Richard H. Steinberg, ‘Politics and Justice at the International Criminal Court’, *Israel Law Review*, 57.2 (2024), 308–50. <https://doi.org/10.1017/S0021223724000049>.

International Criminal Tribunals for the former Yugoslavia and Rwanda. The decision taken by the drafters of the Rome Statute to include references to these tribunals in the ICC Statute was a sign of the influence and interconnected nature of these events.³⁵

To improve the effectiveness of forensic examination in the investigation of war crimes, it is important to expand and improve the training of forensic science and forensics specialists focusing on war crimes investigations. It is also necessary to develop and implement standardized procedures for conducting forensic examinations in cases of war crimes, which will help to unify methods and increase the objectivity of the results. In addition, for the effective use of forensics in the investigation of war crimes, it is necessary to provide specialized laboratories and equipment for collecting and analyzing evidence and to increase the availability of personnel with relevant skills and knowledge in criminalistics.

War crimes are among the most serious violations of international law. Effective investigation of such crimes is critical to establishing justice, bringing perpetrators to justice, and preventing future violations. In this context, forensic science and forensics play a key role in gathering and analyzing the evidence necessary for the successful prosecution of perpetrators.³⁶ War crimes were found to include attacks on civilian targets and energy infrastructure, intentional deaths, unjust imprisonment, torture, rape, and other sexual violence, and the transfer of minors without authorization. According to the findings of A. Chehtman³⁷ the most common definition of a war crime is a “criminalized” violation of war law, but this lacks a strong rationale, leading to varying definitions across statutes. This raises questions about whether past criminalization is necessary for a crime to be prosecutable and whether international criminal law is flexible enough to change over time.

According to current research, the effective investigation of war crimes is carried out despite many challenges and limitations. J. Piccini³⁸ noted in a study of this aspect that the biggest obstacle to justice is that after the regime change, it is in the interests of those political, military, and paramilitary groups involved in these crimes to cover up and erase traces of the crimes as much as possible. Documents and physical evidence are destroyed in an organized or individual manner. Bodies and survivors must be recovered; documents of great importance, such as explosives disposal, accidents, and munitions-related illnesses, will always be destroyed. Some killings result in legal requests for autopsies due to limited resources in the countries concerned and international support for authorities to investigate and analyze.

According to the findings of A. Waterman and J. Worrall,³⁹ the political will of the governments of conflicting countries and warring factions may sometimes be the main challenge in any such investigation. Summarizing the research material, M. de Arcos Tejerizo⁴⁰

³⁵ Mykhaylo Shepitko, ‘Problems of Russian aggression investigation against Ukraine’, *Theory and Practice of Forensic Science and Criminalistics*, 27.2 (2022), 32–43 <https://doi.org/10.32353/khrife.2.2022.03>

³⁶ Olena Aleksandrenko, ‘Problematic issues on the use of forensic analysis during investigation of crimes’, *Theory and Practice of Forensic Science and Criminalistics*, 27.2 (2022), 76–88 <https://doi.org/10.32353/khrife.2.2022.06>

³⁷ Alejandro Chehtman, ‘Revisionist Just War Theory and the Concept of War Crimes’, *Leiden Journal of International Law*, 31.1 (2018), 171–94. <https://doi.org/10.1017/S0922156517000498>.

³⁸ Jon Piccini, ‘On the Genocide Concept’, *Thesis Eleven*, 174.1 (2023), 135–43. <https://doi.org/10.1177/07255136231151500>.

³⁹ Alex Waterman, and James Worrall, ‘Spinning multiple plates under fire: The importance of ordering processes in civil wars’, *Civil Wars*, 22.4 (2020), 567–90. <https://doi.org/10.1080/13698249.2020.1858527>

⁴⁰ María De Arcos Tejerizo, ‘Digital Evidence and Fair Trial Rights at the International Criminal Court’, *Leiden Journal of International Law*, 36.3 (2023), 749–69. <https://doi.org/10.1017/S0922156523000031>.

notes that war crimes investigations pose many political, legal, and technical challenges. War crime investigations often require evidence collection and preservation under physical constraints, requiring careful reconstruction and withstanding restrictions to prove criminal responsibility beyond a reasonable doubt.

C. Roux et al.⁴¹ identified the reasons for the difficulty of applying forensic science and criminalistics in investigating war crimes. It notes that practical, legal, or bureaucratic problems can determine them. The resulting limitations affect the ability to identify and protect evidence and the scientific integrity, context, and probative value of forensic evidence in court. In the absence of forensic evidence, investigators often rely on eyewitness testimony. However, the conclusions of K. King and J. Meernik⁴² that eyewitness testimony has limitations, as it is often less reliable than other forms of evidence and can easily be subject to bias or outright deception.

According to the study by S. I. Ashbridge et al.,⁴³ the use of forensic science in investigations of war crimes and political violence carries significant risks both for the innocent person who is accused and later found to be falsely accused and for the forensic expert who may find himself in the emotionally and politically charged arena of forensic examination. J. Hronešová⁴⁴ highlighted ethical issues in forensics for war crimes investigation, including consent, respect for the dead, justice, privacy, confidentiality, challenges, new technologies, and community relationships.

According to D. A. Lewis,⁴⁵ the definition of war crimes should not be based solely on criminological criteria. Even if not alleged during an armed conflict, it is still significant due to its scale and cruelty. Recognizing such acts' systematic and organized nature is crucial, as they remain unpunished 50 years later. Thus, forensic examination and criminalistics in the context of war crimes are an important part of investigating events related to hostilities. These sciences help establish the circumstances of crimes, collect evidence, and provide expert opinions to bring perpetrators to justice. Determining the principles and methods of forensic science and criminalistics is necessary to ensure an objective and competent investigation of war crimes.

⁴¹ Claude Roux, Sheila Willis, and Céline Weyermann, 'Shifting Forensic Science Focus From Means To Purpose: A Path Forward For The Discipline?', *Science and Justice*, 61.6 (2021) 678–86. <https://doi.org/10.1016/j.scijus.2021.08.005>.

⁴² Kimi King, and James Meernik, 'The Burden of Bearing Witness: The Impact of Testifying At War Crimes Tribunals', *Journal of Conflict Resolution*, 63.2 (2019), 348–72. <https://doi.org/10.1177/0022002717736567>

⁴³ Sarah I. Ashbridge, Patrick S. Randolph-Quinney, Rob C. Janaway, Shari L. Forbes, and Olga Ivshina, 'Environmental Conditions And Bodily Decomposition: Implications For Long Term Management Of War Fatalities And The Identification of The Dead During The Ongoing Ukrainian Conflict', *Forensic Science International: Synergy*, 5 (2022), 100284, <https://doi.org/10.1016/j.fsisyn.2022.100284>.

⁴⁴ Jessie Hronešová, 'Bones and Recognition: Compensating Families of Missing Persons in Post-War Bosnia and Herzegovina', *Journal of Peacebuilding and Development*, 13.2 (2018), 47–60. <https://doi.org/10.1080/15423166.2018.1467784>.

⁴⁵ Dustin A. Lewis, "'War Crimes Involving Autonomous Weapons: Responsibility, Liability and Accountability'", *Journal of International Criminal Justice*, 21.5 (2023), 965–80. <https://doi.org/10.1093/jicj/mqad027>.

4. Conclusion

Criminalistics and forensic science play a crucial role in war crimes investigations, providing a scientific approach to evidence collection and analysis to ensure justice for victims. Ukraine can benefit from the experience of European countries in improving investigative methods, utilizing modern technologies, and fostering international cooperation. Enhancing the effectiveness of war crimes investigations requires modernizing equipment, strengthening the capacity of forensic experts, and standardizing forensic procedures to increase the objectivity of findings. Challenges in war crimes research, such as limited access to information and witness protection, demand a more systematic and internationally standardized approach. Moving forward, research efforts and global cooperation should focus on developing new protocols for evidence collection and strengthening cross-border collaboration. With a more comprehensive and science-based approach, war crimes investigations in Ukraine can become more effective in uncovering the truth and ensuring justice.

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