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Technical and forensic support for the investigation of war crimes: Concept, purpose, individual areas of development

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Abstract
The relevance of this study is conditioned upon the need to investigate the technical and forensic support for the investigation of war crimes that are massively committed in the context of a full-scale military invasion of russia on the territory of Ukraine. The purpose of this study was to define the term "technical and forensic support for the investigation of war crimes", its purpose and components; to consider the technical equipment used to search for people who disappeared during the war, to identify hidden corpses of people who died during the war, to establish their identity. The study employed a set of scientific methods: terminological, system-structural, formal logical, comparative legal. The terms "technical and forensic support" and "technical and forensic means" were analysed, and the definition of technical and forensic support for war crimes was proposed. The following components of technical and forensic support were investigated: scientific, legal, organizational, educational and methodological, scientific and technical, material and technical support. Attention was drawn to the specific features of technical and forensic support for the investigation of war crimes: constant readiness of authorized entities to use technical means and methods; integrated use of technological systems; involvement of numerous information resources; coordination of work on technical equipment of law enforcement agencies with the provision of other departments, including the Armed Forces of Ukraine. The study focuses on the possibility of using technical and forensic support for the investigation of war crimes by security investigators together with National Police investigators. It was concluded that the technical and forensic support for the investigation of crimes includes a system of legal, scientific, organizational measures aimed at the effective use of technical means and their corresponding methods for investigating criminal offences. Promising areas of development of technical and forensic support for the investigation of war crimes are as follows: the use of drone-made evidence (aerial photography); the use of ground-based 3D scanning; the introduction of systems for detecting and visualizing biological traces of participants in war crimes and their victims; the development of identification and search engines for identifying people involved in the commission of war crimes on the territory of Ukraine

Keywords:
technical means; military invasion; search for people; identification of corpses; ground-penetrating radar

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Introduction

Since the beginning of a full-scale military aggression against Ukraine, the necessary conditions for preserving the sovereignty of the state are proper armed confrontation with the russian invaders, maintaining economic policy and social stability.

At the same time, the fight against crime requires constant attention of the state and leads to an improvement in the investigation of criminal offences. "Challenges" for the law enforcement agencies of Ukraine were numerous war crimes: the destruction of citizens' homes, enterprises, institutions, critical infrastructure; mass shootings of civilians, the elimination of Ukrainian servicemen, the genocide of the Ukrainian people, etc. Law enforcement agencies investigate several tens of thousands of war crimes and crimes of aggression, thousands of murders and injuries of the civilian population, and much destruction of civilian infrastructure. At the same time, russian soldiers continue to commit criminal offences in the occupied areas and areas of active military operations, which will become the subject of judicial proceedings later – after the liberation of these territories (Kaluzhna & Shunevych, 2022).

Law enforcement agencies take measures for proper regulatory support, technical equipment, scientific support and information component of the investigation of war crimes. War crimes are new types of criminal offences investigated by investigative bodies (Tataryn, 2022). These criminal offences are characterized by considerable destruction of enterprises, institutions, organizations, housing facilities, the presence of dead both among the civilian population and military personnel, the identification of unidentified corpses, the need to search for missing people. Of significant importance is the proper organization of the investigation according to the legal regime of martial law, which should consider various types of security for the work of law enforcement officers. The stability of the connections between security entities, subjects and objects, the purpose, methods, and means of war crimes investigation at each stage should be considered as a single whole.

Under these conditions, technical and forensic support (hereinafter referred to as TFS) is transformed according to the systems of relations and modern achievements of natural and technical sciences.

In recent years, scientists have developed certain aspects of technical and forensic support for the sphere of countering crime, including activities to solve war crimes. O.V. Kovalova (2022); Ye.Yu. Nikulin (2020); Kh.V. Solntseva (2019) studied the improvement of the information component of the TFS investigation of criminal offences.

Some studies were conducted based on the practice of applying the provisions of the Law of Ukraine "On the Fundamental Principles of Ensuring Cybersecurity of Ukraine"[1]. M.V. Hutsaliuk investigated the latest trends in technical and forensic support for countering cybercrime. Currently, software is being improved to prevent and detect such malicious software as WannaCryptor ransomware, loaders and cryptominers, EternalBlue exploits, etc. (Hutsaliuk, 2021).

Technical and forensic support for the investigation of terrorist acts, criminal explosions, and the investigation of illegal use of explosive materials was investigated by O. Kurman & T. Bodnaruk (2020), M. Koval & I. Koval (2021), A. Farion-Melnyk, I. Melnyk & R. Vasylevskyi (2022).

For instance, A. Farion-Melnyk, I. Melnyk & R. Vasylevskyi (2022) note the use of technical and forensic means depending on the stages of committing criminal explosions. At the same time, the method of committing the crime is considered; manufacturing or searching for means of achieving a criminal purpose; experiments with explosive devices or testing of their individual components and systems; delivery of explosives to the site; arming an explosive substance; initiating an explosion and concealing traces of a criminal offence.

Other scientists analysed the TFS of individual investigative (search) actions, usually a search and seizure. Among them are L.M. Pertsova-Todorova (2021), V.I. Halahan & O.L. Dulskyi (2019); B.B. Teplytskyi (2020).

L.M. Pertsova-Todorova (2021) offers an overview of the technical means used during a search in criminal proceedings. Both the technical equipment itself and the involvement of specialists who have the skills to use it are essential. They record the progress and results of the investigation using technical tools; provide an explanation of the specific features of the items sought during the search; carry out preliminary research of discovered objects on site using special means; discover storage facilities and caches; advise on the safe handling of detected objects, such as explosive devices, weapons, dangerous radioactive and chemical materials, etc.; carry out measurements and help in drafting procedural documents.

At the same time, the concept, purpose, and content of technical and forensic support for the investigation of such urgent criminal offences as war crimes in modern conditions of full-scale military operations in Ukraine, highlighting promising areas of its development, are still understudied.

The purpose of this study was to define the term "technical and forensic support for the investigation of war crimes", its purpose and components; to consider the technical equipment used to search for people who disappeared during the war, to identify hidden corpses of people who died during the war, to establish their identity.

Literature review

Scientific sources contain various positions regarding the technical component of the investigation of war crimes,

[1]Law of Ukraine No. 2163-VIII "On the Fundamental Principles of Ensuring Cybersecurity of Ukraine". (2017, October). Retrieved from https://zakon.rada.gov.ua/laws/show/2163-19#Text.

their types, and purpose of application. Even various terms are used, including "technical and forensic support for the investigation of crimes", "technical and forensic support for investigative activities", "technical means", "special technical means of forensics", "scientific and technical means", "technical and forensic means". Accordingly, disputes arise between scientists regarding the expediency of using a particular term, and a mechanism for technical equipment of pre-trial investigation bodies is being developed according to modern needs for detecting, documenting, and solving war crimes.

Ukrainian researchers focused on various aspects of the issues related to technical and forensic support for the investigation of criminal offences.

Specifically, O.V. Kovalova (2022) considered the improvement of the legal aspect of the TFS investigation of criminal offences. The researcher identified one of the ways to improve the information support of crime investigations, the development of programs that allow comparing questionable information and verify it according to other sources.

To avoid risks in the information component, it is planned to develop technical support programs that will track software errors to avoid and correct them; reduce corruption risks due to restricting access to unreliable users; use programs that simultaneously identify questionable information and compare it with reliable data (Kovalova, 2022). G.M. Shorokhova (2019) concludes that the regulatory framework in the field of information and telecommunications technologies is inconsistent with modern requirements and the pace of development of society, the cumbersome, contradictory, and complementary nature of legal regulation in various regulations, and the need for unification and harmonization of these regulations, especially with the European legislation.

S. Perlin (2020) offers the levels of authorized subjects of technical and forensic support: the first level is the provision of law enforcement activities in general; the second – technical equipment for the activities of the bodies of the sphere of justice; the third – technical and forensic support of individual departments, and the fourth – equipping individual subjects of the investigation. Perlin singles out the technical support of the investigation of certain types of criminal offences as an element of ensuring the investigation of crimes, as well as the technical support of the conduct of certain investigative actions, using the help of specialists.

O. Kurman & T. Bodnaruk (2020) consider the relationship between the tactics of a separate investigative action and its technical and forensic support as a prerequisite for the effectiveness of the investigation of committed terrorist acts. Kurman and Bodnaruk note that for effective solving of a terrorist act during the inspection of the scene, several specialists should be actively involved – sappers, explosives technicians, forensic specialists, canine handlers with specially trained dogs, forensic doctors, chemists.

B.B. Teplytskyi (2020) investigated search and seizure as an important activity in the investigation of crimes related to the use of computers, systems and computer networks and telecommunication networks, its technical and forensic support. He focused his study on methods of detecting evidentiary information in computers and their systems; recommended that before conducting procedural actions, measures should be taken to prevent damage or destruction of computer information, and to ensure the involvement of a specialist programmer or other specialist in the field of computer technology.

However, the issues of technical and forensic support for the investigation of war crimes are understudied because this category is relatively new for the Ukrainian forensic science. Therefore, the study of the stated problem of technical support for the investigation and the proposal to solve certain issues is relevant in theoretical and practical aspects.

Materials and Methods

During the preparation of this study, a number of general scientific and special methods were used. *The dialectical method* was employed as a general method of scientific cognition. It allowed considering the issue of technical and forensic support for the investigation of war crimes in dynamics, covering their interrelationship and interdependence, This method was used to investigate the legal nature and specific features of the technical equipment of law enforcement agencies in the conditions of the need to work during active hostilities or in dangerous circumstances, beyond the consequences of the war. Such general scientific methods as *observation, comparison, description, classification* contributed to the definition and systematization of legal categories of technical support of law enforcement agencies in the aspect of combating modern criminal activity in general and the investigation of war crimes in particular.

Methods of analysis and synthesis were used to formulate conclusions and generalizations in the context of the subject of under study. *Synergetic method* provided an opportunity to investigate the processes of criminal activity in areas of active military operations and in the de-occupied territory, legal relations in countering war crimes as a certain system, characterized by irregular ties, functional instability, violation of international humanitarian law, especially in their crisis, unstable states. *The dogmatic method* allowed interpreting the terminology of the criminal procedure, criminology, forensic expertise, which contributed to the clarification of the terminology of this study.

Thanks to the application of *the terminological method*, the terms "technical and forensic support", "technical and forensic support for the investigation of war crimes", "technical and forensic means" were investigated. The author's terms "technical and forensic support for the investigation of criminal offences", "technical and forensic support for the investigation of war crimes" were

proposed. To provide a comprehensive scientific approach to the examination of the features of technical and forensic support for the investigation of war crimes in modern conditions, a *system-structural method* was used.

The axiomatic method was used to construct statements on the expediency of using certain technical means to solve the tasks of investigating war crimes, obtaining other knowledge in the field of technical and forensic support for combating crime according to the rules of logic. T*he formal-logical method* helped analyse the trends of statutory regulation of the use of genomic information about a person in modern electronic registers, to forecast the trends of the development of Ukrainian legislation in this area. *The comparative legal method* was applied to analyse the use of technical and forensic support for the investigation of numerous objects in different countries, including the use of devices for scanning the upper layer of the soil.

The typology method allowed singling out the main groups of technical equipment for the investigation of war crimes based on the commonality of essential features from a considerable number of types of technical and forensic support for pre-trial investigation. *The modelling method was used to develop and put into practice action algorithms for finding burial sites of those who suffered a violent death during hostilities, as well as searching for missing people. The hypothetical method* allowed developing recommendations for the use of search radar equipment based on the study of its tactical characteristics and technical content.

During the preparation of this paper, provisions of the following regulations were used: the Laws of Ukraine "On the Fundamental Principles of Ensuring Cybersecurity of Ukraine"[1], "On State Registration of Human Genomic Information"[2], "On the National Police"[3], Criminal Procedural Code [4]; Orders of the Ministry of Internal Affairs of Ukraine (MIAU) on the Information Portal of the National Police of Ukraine[5] and the system of forensic records of the Expert Service of the MIAU[6], modern scientific sources with the results of research into the use of certain technical and forensic means in the fight against crime, including the investigation of war crimes.

Results

TFS is a system of certain legal, scientific, organizational, and applied measures for the creation, implementation, and application of technical means for the effective investigation of criminal offences.

TFS is an activity carried out by law enforcement agencies aimed at creating reliable conditions for their constant readiness to use forensic techniques and means when necessary to prevent, investigate, and solve criminal offences (Areshonkov, 2020).

The TFS investigation of war crimes is an organizational and functional integrity that creates conditions for the constant readiness of law enforcement agencies for timely, complete, and comprehensive resolution of technical and forensic issues, and allows the implementation of these conditions for obtaining, accumulating, processing evidentiary information and its application upon investigating war crimes (Stepaniuk, 2022).

TFS, being an organizational and functional system aimed at achieving a dual purpose (creating conditions for readiness and practical implementation of tasks), contains several areas:

– improvement of research activities (scientific support);

– development of proposals for improving criminal procedural legislation, departmental and interdepartmental regulations governing the practice of targeted application of forensic technical means and methods (legal support);

– improvement of the organizational structure of forensic units, forms and methods of their activities, interaction with other subjects of application of technical and forensic tools and methods (organizational support);

– support of the level of technical and forensic training of subjects of TFS application (educational and methodological support);

– modernization and creation of new technical and forensic tools and methods (scientific and technical support);

– improving the level of equipment of subjects using technical and forensic tools and methods and organizing its preventive maintenance (material and technical support) (Teplytskyi, 2021).

Thus, TFS crime investigation is a system of legal, scientific, organizational, and practical measures to create, implement, and apply technical means of pre-trial investigation for timely, comprehensive, and effective implementation of criminal proceedings.

In the conditions of the use of modern forensic technologies during the war, technical and forensic

[1]Law of Ukraine No. 2163-VIII "On the Fundamental Principles of Ensuring Cybersecurity of Ukraine". (2017, October). Retrieved from https://zakon.rada.gov.ua/laws/show/2163-19#Text.
[2]Law of Ukraine No. 2391-IX "On State Registration of Human Genomic Information". (2022, July). Retrieved from https://zakon.rada.gov.ua/laws/show/2391-20#Text.
[3]Law of Ukraine No. 580-VIII "On the National Police". (2015, July). Retrieved from https://zakon.rada.gov.ua/laws/show/580-19#Text.
[4]Law of Ukraine No. 4651-VI "Criminal Procedural Code of Ukraine". (2012, April). Retrieved from https://zakon.rada.gov.ua/laws/show/4651-17#Text.
[5]Order of the Ministry of Internal Affairs of Ukraine No. 676 Regulations on the information and telecommunication system "Information Portal of the National Police of Ukraine". (2017, August). Retrieved from https://zakon.rada.gov.ua/laws/show/z1059-17#Text/.
[6]Order of the Ministry of Internal Affairs of Ukraine No. 390 "On the Approval of the Instructions for the organization of the functioning of forensic record of the expert service of the Ministry of Internal Affairs". (2009, September). Retrieved from https://zakon.rada.gov.ua/laws/show/z0963-09#Text.

support for the investigation of criminal offences should be supplemented with elements that reflect its current essence. Namely, as an organizational system for the creation of conditions for the constant readiness of services and units to quickly, timely, and effectively solve technical and forensic tasks in the conditions of martial law, based on systemic types of interaction and the wide use of the complex purpose of technological systems, for coordinated processing of forensically significant data and obtaining it in information systems in a form suitable for the direct activity of law enforcement agencies and coordination of services with various departments, institutions, units, predominantly the Armed Forces of Ukraine (AFU).

The investigation of war crimes entails obtaining, processing, and using information, since the number of information connections and interactions is complicated, and with the growing number of consequences of war crimes, the volume of information increases to a level that exceeds the human ability to process and use them systematically. At the same time, informatization, like any social phenomenon with positive advantages, unfortunately, also has negative consequences, namely the possibility of using computer technologies to commit offences, including crimes (Stratonov *et al*., 2021). With the specifics of efficiency and the need to comply with procedural requirements for solving the tasks of criminal proceedings on war crimes, it includes the effectiveness of methods for improving the quality of law enforcement intelligence and investigative work, the degree of effectiveness of its TFS on machine-free principles of its implementation. Digital technologies play an essential role in shaping the global landscape of criminal proceedings in several jurisdictions. Specifically, forecasting algorithms are now used for decision-making at almost all levels of criminal proceedings (Ugwudike, 2022).

The author of the study believes that the purpose of the TFS investigation of war crimes is a certain "coordination vector" of pre-trial investigation of these criminal offences. The tasks of the corresponding support include facilitating the collection of evidentiary information by authorized subjects, the involvement of specialists with technical knowledge and skills (military science, medicine, forensics, bomb disposal, etc.), practical implementation within the procedural competence of pre-trial investigation.

Pursuant to Part 2 of Article 216 of the Criminal Procedural Code of Ukraine[1], war crimes are investigated by investigators of security agencies. This activity is costly, considering technical means and human resources involved. Therefore, authorized subjects of other law enforcement agencies, namely investigators of the National Police, are involved in the investigation of war crimes (Tataryn, 2022).

Under these conditions, not only a new TFS system for investigating crimes in war conditions is being formed at a fundamentally new level, but also its technology, which in terms of intensifying forensic decisions will be able to provide an offensive level, working proactively and standing an order of magnitude higher than the TFS systems that existed earlier. This will objectively ensure the increased needs of technical equipment for combating war crimes.

For instance, information support is used to assist operational decision-making when a particular crime is detected. Scientists claim that this approach to grouping certain types of crimes within existing criminal offences is an effective potential of investigative bodies, which is successfully used by criminal analysts (Birks *et al*., 2020).

Thus, the main and priority areas of development of the TFS investigation of war crimes in modern conditions includes the solving of relevant offences using automation, computer technology, and modern information and high technologies, based on the creation and provision of the functioning of information identification and search systems for technical and forensic purposes. Such tools include control systems for the police and other law enforcement agencies; mobile applications for smartphones and tablets for recording the consequences of war crimes; unmanned aerial vehicles (UAVs) with functions of aerial photography of the consequences of war crimes (Using achievements…, 2021); OSINT (Open-source intelligence) technologies for searching the Internet based on the appearance of people through automated face recognition programs (Stepaniuk, 2022).

The level of technical and forensic means, capable of full use in the conditions of warfare, is only an intermediate stage of solving modern forensic tasks and cannot provide it to the full extent. As a result, it is necessary to create forensic technologies that ensure the systematic interaction of all hierarchies of the TFS system of various law enforcement agencies in its systematic form, capable of working from local to global level with effective feedback systems and ensuring the use of the obtained data in the direct activities of criminologists, specifically in the "hot pursuit". Such activities will form a new unified forensic space, where forensic technologies will be able to provide a conveyor system for systematic processing of all levels and types of forensically significant information on any facts of war crimes. This will form the modern TFS system as a mega-instrumental technology of criminal procedural relations in the investigation of war crimes.

Evidently, most forensic knowledge can only be implemented using technical means. In the conditions of martial law, the further aggravation of operational and combat circumstances and the complication of types of criminal activity, which requires adequate actions within

[1]Law of Ukraine No. 4651-VI "Criminal Procedural Code of Ukraine". (2012, April). Retrieved from https://zakon.rada.gov.ua/laws/show/4651-17#Text.

the limits of TFS, all modern research complexes and systems of instrumental purpose consist of algorithmic, technical, and energy-providing subsystems, which most often perform complex tasks, and their combination into a unified complex forensic system as the basis for the formation of a unified forensic environment. This refers to the information and telecommunications system "Information Portal of the National Police of Ukraine"[1] and the system of forensic records of the expert service of the Ministry of Internal Affairs.[2]

The formalization of the scientific development of forensics lies in the detailing of forensic knowledge, and as an external manifestation of increasing its effectiveness – penetration into increasingly subtle levels of knowledge about the essence of natural systems and the place of humans in them. In a practical aspect, this indicates the use of various objects that are carriers of traces of military actions, increasingly close to intangible traces, for the purpose of proof.

Therefore, the significance of the formation of a highly effective system of TFS investigation of war crimes lies in the development of a holistic comprehensive system of both search and research level based on the created and functioning information and communication bases, the transition of which from level to level would be carried out depending on the nature of the tasks performed and the level of requirements for particular facts both in terms of scope and level of analysis of necessary decisions.

One of the areas of TFS application for the investigation of war crimes is the search for missing people and the identification of concealed burial sites containing victims of war crimes: military personnel, civilians, minors.

In this aspect, the issue of TFS for the search for missing persons in the conditions of martial law is important.

In general, the search for a missing person is a complex activity involving a wide range of multi-level tactical, methodological, and scientific-technical tasks aimed at achieving a common purpose of establishing the location of a person (Nykyforchuk & Chemerys, 2018). Photographs, video recordings, screenshots of messengers, description of appearance (distinctive features, accompanying and functional signs), handprints, samples of handwriting, blood, hair, and other objects act as traces and their carriers.

In terms of the search for missing people and the identification of corpses in wartime, the problem of expanding the complex of human identification features using dental status, DNA code, and other features is quite promising. The role of police officers and forensic experts is essential in this aspect.

Specifically, the police form their own information resources. Pursuant to Article 26 of the Law of Ukraine "On the National Police"[3], the information and communication system of the police is filled with up-to-date registers, databases, which constitute a holistic information system of the MIAU, including the search for missing people. When filling the registers and databases (banks) of data specified in Clause 7, Part 1 of Article 26 of the Law of Ukraine "On the National Police"[4], police officers collect and accumulate multimedia information (photo documents, video and sound recordings), biometric data (digitized images of a person's face, fingerprints, scanned fingerprint cards). Work with biometric data is carried out based on the law and according to the procedure established by the MIAU.

Currently, Ukraine has adopted the Law "On State Registration of Human Genomic Information"[5], which will come into force on February 6, 2023. According to the specified law, an Electronic Register of Human Genomic Information is introduced, the holder of which is the MIAU. Mandatory and voluntary state registration of genomic information is provided. The categories of mandatory registration are as follows:

– individuals suspected of committing grave or especially grave crimes against the national security of Ukraine, life and health, freedom, honour and dignity, sexual freedom and inviolability of the person, property, public security, drug trafficking, crimes against peace, human security and international law and order, or in respect of whom criminal proceedings of the above-mentioned types of crimes have been sent to court;

– unidentified corpses, their remains, body parts, upon the facts of which criminal proceedings have been initiated, and the corresponding data are contained in the Unified Register of Pre-Trial Investigations;

– identified individuals, whose samples were compared with samples of individuals who disappeared, on the facts of whose disappearance criminal proceedings were initiated, and the relevant data are contained in the Unified Register of Pre-Trial Investigations.

At the initial stage of the search, the testimony of relatives, acquaintances, and colleagues of the missing individual is important. They can not only specify the circumstances of the disappearance (time, place, plausible causes, etc.), but also provide assistance in detailing the circumstances of the disappearance.

[1]Order of the Ministry of Internal Affairs of Ukraine No. 676 Regulations on the information and telecommunication system "Information Portal of the National Police of Ukraine". (2017, August). Retrieved from https://zakon.rada.gov.ua/laws/show/z1059-17#Text/.
[2]Order of the Ministry of Internal Affairs of Ukraine No. 390 "On the Approval of the Instructions for the Organization of the Functioning of Forensic Record of the Expert Service of the Ministry of Internal Affairs". (2009, September). Retrieved from https://zakon.rada.gov.ua/laws/show/z0963-09#Text.
[3]Law of Ukraine No. 580-VIII "On the National Police". (2015, July). Retrieved from https://zakon.rada.gov.ua/laws/show/580-19#Text.
[4]Ibidem, 2015.
[5]Law of Ukraine No. 2391-IX "On State Registration of Human Genomic Information". (2022, July). Retrieved from https://zakon.rada.gov.ua/laws/show/2391-20#Text.

As the analysis of the investigative practice of investigating war crimes committed in Ukraine shows, the places where corpses are hidden are, as a rule, forest areas, landfills, wastelands, cesspools, wells, tunnels of water pipes and cable networks. Proceeding from the assumed place of hiding the corpses, various technical means are used (entrenching tool): shovels (for excavation), dredges and trawls (for surveying reservoirs), rakes (for surveying the area covered with brush and leaves). Drills and probes are used to detect objects buried in the ground. Therewith, signs of digging and loosening should be considered: modified soil, withered vegetation, holes in the soil, etc. (Stepaniuk, 2022).

For forensic specialists involved in the examination of corpses (which are often infectious, decomposed, with the presence of pediculosis, etc.), a set of personal protective equipment has been developed – special clothing such as solid overalls (Participation of a forensic specialist…, 2018).

In search activities, it is sometimes very time-consuming to search for the corpses of both killed servicemen of the Armed Forces of Ukraine and the civilian population buried by the russian invaders (Klymenko, 2022). To identify corpses in the ground and their parts, there is an exhaustive list of search equipment. Specifically, for this purpose, a corpse detector – the chemical agent monitor "Poshuk-1" is used. However, the capabilities of this device are limited, since it cannot be used for examining frozen soil (in winter, corpses freeze and decay does not occur), the probe of the device cannot be immersed below the level of groundwater and in marshy soil (Webportal of the National…, 2021).

The special electroprobe "IBM-1" has greater efficiency, the principle of operation of which is based on recording and measuring the electrical conductivity of the soil in separate places (if there is a buried corpse – the electrical conductivity of the soil increases considerably). This property means that during the decomposition and separation of the protein substances of the corpse, gaseous and liquid substances enter the soil, and this increases the electrical conductivity of the ground in the corresponding place, the strength of the current, which is recorded by a microammeter, increases (Webportal of the National…, 2021).

Together with the specified devices, the gas alarm "DZHYN-HAZ" and the chemical agent monitor "PGI-1" (field) can be used (Webportal of the National…, 2021).

If available on the territory, if necessary, law enforcement officers use a trawl to search small bodies of water. It facilitates the detection of a corpse or its parts in the water, with its help, the corpse's clothes, shoes, weapons, and other items are pulled out (Webportal of the National…, 2021).

At the current stage, the efforts of criminologists are aimed at improving devices for detecting corpses that are not connected with the need for mechanical penetration into the soil (Use of achievements..., 2021).

The author believes that the use of subsurface sounding radar devices (geographic radars) is promising in the search for missing persons and the identification of corpses of people killed during the war. Their work is based on the use of classical radar principles. The transmitting antenna of the device emits ultrashort electromagnetic pulses.

The most well-known radar devices are as follows: Airborne radar; Surface-Penetrating radar; Pulse radar (radar that emits a repeated series of scanning pulses); High-resolution radar (radar with the ability to detect objects in the distance range from a meter to several centimetres); Pulse compression radar (uses a long pulse with internal modulation); Surveillance radar (radar that detects the presence of a target and determines its location by range and angle); Tracking radar (provides tracking of the target's trajectory); Imaging radar (creates a two-dimensional image of a target or part of the earth's surface and what is on it); Weapon control radar (usually used in the air defence system); Target recognition (effective remote sensing device); Multifunction radar (designed to perform several functions of scanning, searching, and detecting objects) (Borrion, Amiri & Delpech, 2019).

In Ukraine, ground-penetrating radars of the "OKO" series are used. The devices are a new series of high-speed, high-performance ground-penetrating radars that allow sounding three times faster while increasing the quality of the radarogram. When working with the "OKO" series ground-penetrating radar, operators can use tablets, smartphones, netbooks, and other portable computer equipment, perform high-precision coordinate reference, and use new software options ("OKO-3" ground-penetrating…, 2022). These ground-penetrating radars provide sensing of different environments, soils, and waters at different depths.

As the analysis of the practices of France, the Netherlands, Great Britain (Stepaniuk, 2022) showed, the use of ground-penetrating radars with optical and hyperspectral cameras allows remote detection of various objects, namely those located in dangerous or hard-to-reach places. Ground-penetrating radars can operate in different environments – space, atmospheric air, sea, land, underground, and under different weather conditions (darkness, haze, fog, rain, or snow) (Borrion, Amiri & Delpech, 2019).

Flexible technical video endoscopes are used for inspection and visual inspection of closed, light-insulated rooms or those with small openings, hard-to-reach areas. They are equipped with video equipment for recording and monitoring in real time. The advantage of these devices is that they can work in a hostile environment (Webportal of the National…, 2021).

If the place of burial of corpses is under brick structures or concrete floors, then special devices with a built-in digital image processing system can be used to detect voids under them (Webportal of the National…, 2021).

Considering forensic recommendations, after the discovery of the corpse or its remains, it is necessary to establish the identity of the deceased. For this, a forensic medical examination establishes the statute of limitations and cause of death, the method of murder, examines the traces of the crime on the body of the deceased, their clothes, objects, and identifies the corpse. The use of dactyloscopic kits (for obtaining fingerprints and their subsequent verification against the records of the Expert Service of the MIAU and the National Police of Ukraine), kits for the selection of DNA material helps establish the identity of an unknown corpse. (Participation of a forensic specialist..., 2018).

Plastic models (masks and casts) are used to effectively extract three-dimensional traces and record signs of the appearance of unidentified corpses. The most common means of this group are impression materials for working with volumetric traces: gypsum, polymer and silicone pastes – paste "K", U1, U-4, SKTN, KLSF-305, KLT-30, "Sielast" (Participation of a forensic specialist..., 2018).

In the aspect of the TFS investigation of war crimes, it should be noted about the computer equipment and software used during the portrait examination. Specifically, if the soft tissues of the face show signs of destruction, then when examining photographs of such unidentified corpses, the expert is additionally sent X-rays of the skull or the skull itself. In this case, a comprehensive portrait and medical-forensic examination is carried out (Forensic examinations..., 2019).

Discussion

In the modern conditions of the full-scale military invasion of the russian army in Ukraine, the de-occupation of certain territories of Ukraine and the need to document the actions committed by the russian military personnel, it is extremely necessary to analyse the technical and forensic support for the investigation of war crimes, to formulate recommendations for its use and improvement, and to develop promising areas for the development of technical equipment of law enforcement agencies.

Ukrainian researchers have developed a certain set of recommendations on TFS for countering crime, which can be used in the investigation of war crimes. The vast majority of scientific results (Kovalova 2022; Nikulin 2020; Shorokhova 2019) relate to the information component of the TFS investigation. According to the results of the present study, it is advisable to use this improvement in preventing information and psychological attacks both within cyberspace and at the level of social networks and "fake news". It is recommended to use it to protect objects of critical information infrastructure of Ukraine from cyberattacks, as well as to preserve information with restricted access, including those data that constitute state secrets.

The current provisions on TFS for the investigation of terrorist acts, criminal explosions, and the investigation of the illegal use of explosive materials (Kurman & Bodnaruk, 2020; Koval & Koval, 2021; Farion-Melnyk, Melnyk & Vasylevskyi, 2022) are already used during the demining of de-occupied territories of Ukraine, work on the detection, extraction, research of evidence of the use of missile and artillery weapons primarily against the civilian population of Ukraine, the destruction of residential and non-residential stock, enterprises, institutions, organizations, and energy system facilities.

At the same time, the technical means used to detect hidden "criminal" corpses or to scan the upper layer of the earth's surface, combing water bodies, should be used to identify the burial sites with corpses of those killed as a result of murders committed by russian servicemen, to search for missing people, and to establish their identities. The authors of this study found that among the relevant technical equipment, the most effective results are obtained by using radars.

As the analysis of the capabilities of some radars, such as Airborne, Pulse, High-resolution, Tracking, Imaging, Weapon control, Multifunction, etc. showed, the Ukrainian GPR of the "OKO" series have certain advantages that allow them to be used in the search for missing people and detection of corpses of people killed during the full-scale military invasion of russian troops on the territory of Ukraine. Specifically, the "OKO-3" GPR is characterized by scanning an increased number of points by depth – up to 2048 and more; improved radargram quality; increased scanning speed – up to 350-400 scans/sec (at 512 points); high-speed two-channel control unit (total probing speed 700-800 traces/sec.); built-in Wi-Fi in the control unit for connecting to a laptop or other control device; more precise positioning by enabling GPS connection to the control unit; "intelligent" displacement sensor – the sensor parameters are recorded in its "independent" memory and are automatically set when turned on; an updated version of the "Geoscan 32" software for the Android operating system for the use with protected tablets and smartphones.

Conclusions

Thus, TFS for the investigation of war crimes is an organizational system of equipping law enforcement and other bodies, aimed at creating conditions for the constant readiness of services and units to quickly, timely, and effectively solve technical and forensic tasks under martial law, based on systemic types of interaction and wide use of the complex purpose of technological systems, for coordinated processing of forensically significant data and obtaining it in information systems in a form suitable for the direct activity of law enforcement agencies and coordination of services with various departments, institutions, units, including the Armed Forces of Ukraine.

The purpose of TFS for the investigation of war crimes is determined by the modern tasks of law enforcement agencies regarding their activities in de-occupied

territories and places where war crimes are committed. Such purpose determines the relevant level of technical equipment and corresponding training of employees.

TFS of the following groups are used to search for missing people and identify corpses of people who died during the war: technical devices, including an entrenching tool; special security of professional activities of specialists involved in investigative procedures; special search devices and equipment.

The prospects for the development of TFS are its formalization and transformation of scientific methods into technologies of forensic systems, as a fact of bringing the provision of the system in line with the level of information interactions of the parties involved in criminal proceedings.

Promising areas of the TFS development for the investigation of war crimes are the active introduction and use of aerial photography (UAVs with software for documenting war crimes sites); 3D scanning of the situation at the site of war crimes; technologies for detecting and identifying biological traces, including in field conditions; identification and search systems for establishing military personnel of the aggressor country regarding their commission of war crimes.

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Техніко-криміналістичне забезпечення розслідування воєнних злочинів: поняття, мета, окремі напрями розвитку

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Анотація
Актуальність статті обумовлена необхідністю дослідження техніко-криміналістичного забезпечення розслідування воєнних злочинів, які масово вчиняються в умовах повномасштабного військового вторгнення росії на територію України. Мета статті полягає у визначенні поняття техніко-криміналістичного забезпечення розслідування воєнних злочинів, його мети і складових; розгляді технічного оснащення розшуку безвісно зниклих під час війни осіб, виявлення прихованих трупів осіб, загиблих під час війни, встановлення їхньої особи. У статті використано комплекс наукових методів: термінологічний, системно-структурний, формально-логічний, порівняльно-правовий. Проаналізовано зміст понять «техніко-криміналістичне забезпечення», «техніко-криміналістичний засіб», запропоновано визначення техніко-криміналістичного забезпечення воєнних злочинів. Досліджено складові техніко-криміналістичного забезпечення: наукове, правове, організаційне, навчально-методичне, науково-технічне, матеріально-технічне забезпечення. Акцентовано на особливостях техніко-криміналістичного забезпечення розслідування воєнних злочинів: постійна готовність уповноважених суб'єктів до застосування технічних засобів і методів; комплексне використання технологічних систем; залучення низки інформаційних ресурсів; координація роботи з технічного оснащення правоохоронних органів із забезпеченням інших відомств, зокрема Збройних сил України. Акцентовано на можливості використання техніко-криміналістичного забезпечення розслідування воєнних злочинів слідчими органів безпеки спільно зі слідчими Національної поліції. Доведено, що до техніко-криміналістичного забезпечення розслідування злочинів належить система правових, наукових, організаційних заходів, спрямованих на ефективне застосування технічних засобів і відповідних їм методів з метою розслідування кримінальних правопорушень. Перспективними напрямами розвитку техніко-криміналістичного забезпечення розслідування воєнних злочинів є: застосування дронової фіксації (аерофотографії); використання наземного 3D-сканування; запровадження систем виявлення та візуалізації біологічних слідів учасників воєнних злочинів та їхніх жертв; розроблення ідентифікаційно-пошукових систем встановлення осіб, причетних до вчинення воєнних злочинів на території України

Ключові слова:
технічні засоби; військове вторгнення; розшук осіб; ідентифікація трупів; георадар