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## Latest technologies in criminal investigation (testing of foreign practices in Ukraine)

### Новітні технології у розслідуванні злочинів (апробація закордонних практик в Україні)

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#### Abstract

The aim of the article was to identify a set of innovative technologies in the field of investigation of crimes that can be tested in Ukraine. The leading research methods were the method of comparison, observation and comparative method. The activities of law enforcement agencies in the field of combating crime and ensuring the introduction of innovative technologies in the investigation of crimes were analyzed in the course of this research. It is substantiated that Ukraine is going through high-quality reform and legislative innovations, taking into account the best world practices. It is concluded that it is necessary to improve new sections of forensic science — digital forensics and develop a Strategy for investigating crimes in the digital age. These actions will promote the integration of the latest advances in science and

#### Анотація

Метою статті стало виявлення комплексу інноваційних технологій у сфері розслідування злочинів, які можуть бути апробовані на теренах України. Провідними методами дослідження виступили – метод співставлення, спостереження та компаративний метод. У процесі наукового пошуку було проаналізовано діяльність правоохоронних органів у сфері протидії злочинності та забезпеченні впровадження інноваційних технологій у процес розслідування злочинів. Обґрунтовано, що з боку України наразі приймаються рішучі заходи законодавчого характеру, які базуються на міжнародному досвіді. Зроблено висновок про необхідність вдосконалення нових розділів криміналістичної науки – цифрової криміналістики та розробки Стратегії

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technology into criminology, the development of certain theoretical positions, and optimize the detection and investigation of crimes. Further research will be based on the gradual introduction of positive European experience in this area.

**Keywords:** innovations, investigative actions, digital traces, crime investigation, forensic algorithm.

## Introduction

The current state of computerization can be seen as a social phenomenon, a progressive stage of human development and a negative stimulus that provoked the emergence of new crimes. The advent of advanced criminal offenses related to the innovative component of society and information technology necessitates transformations in the methodology and approaches to the investigation of crimes. Analogue data has been replaced by digital data format, monofunctional means of cinematography — by universal means of digital videography due to dynamic scientific and technological progress (Baryshnikov & Chervyakov, 2018). The possibility, and in some cases the need, to use innovative technical means and technologies in the investigation of crimes have been gradually enshrined in various areas of law of different states.

Over the last decade, international forensic scientists have increasingly relied on digital technology to search for facts related to crimes, their detection and prevention (Agibalov, 2012). Initially, the use of innovative technologies was considered an inefficient and unproven practical innovation. At the same time, ways have gradually been devised to combine large volumes of online information and digital techniques to obtain data relevant to the investigation of various crimes around the world.

Moreover, rapid technological development has given rise to cybercrime. Most often, criminals use technology to plan and commit complex crimes. Computers, smartphones, flash drives, and cloud storage are some of the many types of devices that store digital data. This is why scientists and practitioners face a new challenge — updating approaches to the collection, analysis and storage of digital data and evidence (Singh, 2018). The legal nature of the use of this

розслідування злочинів у цифрову епоху. Наведені дії сприятимуть інтеграції в криміналістику останніх досягнень науки і техніки, розвитку окремих теоретичних положень й оптимізації розкриття і розслідування злочинів. Подальші наукові дослідження базуватимуться на поступовому впровадженні позитивного європейського досвіду у окресленій царині.

**Ключові слова:** інновації, слідчі дії, цифрові сліди, розслідування злочинів, криміналістичний алгоритм.

data in court proceedings becomes especially relevant.

Scientists state that we can talk about the formation of a new branch of forensic science — digital forensics (Raina, 2020). It involves the recovery, analysis and storage of any information found on digital devices; this branch of criminology often deals with cybercrime. The term “digital forensics” was originally used as a synonym for computer forensics, but has now expanded to include information analysis on all devices that can store digital data (Khan et al., 2021). Digital forensics experts respond to cases such as server hacking or leaks of confidential information. Their specialized forensic tools help them investigate incidents, analyses traffic, and search for hidden data and other evidence. They collect, recover and store the data necessary for the investigation, prepare and submit them to the court. Depending on the type of information and its sources, digital forensics has its branches and requires special professional training. Testing of the best world practices in the investigation of crimes becomes especially relevant in the context of updating the preservation of financial and personal data, intensification of cross-border crime and recurrent mass leaks of confidential information.

The current positive trends in the fight against crime are fragmentary in Ukraine. A rather low efficiency of pre-trial investigation is mainly due to imperfect reforms of law enforcement and the judiciary, outdated methods of crime investigation, legal nihilism of society and the state’s unwillingness to comprehensively integrate the innovation component into investigative mechanisms given significant financial costs. Despite these negative factors, the Ukrainian cyberpolice develops and successfully implements modern methods of detection, recording and research of digital

evidence (Cabinet of ministers of Ukraine, 2020). At the same time, the gradual introduction of foreign experience faces many practical obstacles and gaps in the legislation. The corruption component remains a particularly negative factor on the way to an effective fight against crime. During the years of independence in Ukraine, corruption was steadily formed at all levels of state power and local self-government, which led to difficulties in overcoming it.

This negative factor has its impact on the reform drive for change in the state, and the corruption schemes delay the European integration processes. Corruption is recognized by ordinary citizens as the most difficult and insurmountable problem of the state. The international community also shares the position of Ukrainian society. For example, according to Transparency International, Ukraine ranked 117th in the Corruption Promotion Index in 2020 (Transparency International Ukraine, 2020). In general, the Global Peace Index, edited by the Australian Institute of Economics and Peace, ranks Ukraine 152nd out of 163. The criteria are the level of social security, the degree of ongoing domestic and international conflict, and the level of militarization (Global Peace Index, 2020).

The Geneva-based World Economic Forum ranks Ukraine 127th out of 136 countries in terms of security. The criteria are business costs related to crime and violence, the reliability of police services, business costs related to the threat of terrorism, terrorism index and the homicide rate (World economic forum, 2020). The US Overseas Security Advisory Council (OSAC) assesses Ukraine as Level 2 risk country, and recommends Ukraine to be cautious against the background of crime and civil unrest. Kyiv is assessed as a place where there is a great threat of crime (Data center security systems, 2021).

Ukraine has recently taken significant progressive steps to ensure an effective fight against crime. In particular, the state implemented the main recommendations of relevant international organizations. Unfortunately, these measures have proved ineffective in the courts. Besides, the corrupt background of crime and the inextricable link with oligarchic clans remain insurmountable in Ukraine. This is manifested, among other things, in the control of criminality over electoral and state processes at various levels through the nomination of candidates to state and judicial bodies, executive bodies, as well as control and supervisory institutions. Unfortunately, the pressure of crime and oligarchic clans on all

spheres of public administration in Ukraine remains unchanged and stable despite the large number of reforms and legislative transformations. Such a set of variable criminal actions requires a qualitatively updated approach to the investigation of crimes. In this context, the tendency to improve approaches to the investigation of crimes seems reasonable (Yaacoub et al., 2021).

In view of the above, the aim of the article is to find the best foreign practices of using innovative technologies in the investigation of crimes for further testing in Ukraine. The aim involved the following objectives: 1) identify the leading innovations used by law enforcement agencies to investigate crimes abroad; 2) outline a list of priority reforms on the territory of Ukraine in order to ensure the most effective investigation of crimes taking into account foreign practice.

### Literature review

The choice of research topic correlates with modern vectors of scientific research of representatives of the doctrine in different countries. The work of Perlin and Stepaniuk (2020) was the leading tools and basis for our article. In the process of research, scientists have summarized the grounds for defining the concept of forensic technology used by Ukrainian and European scientists, proposed their own definition of the concept. The work of Shepitko (2019) also had an impact on the formation of the authors position on the research topic. The work of these scientists made it possible to outline the vector of research on the transformation of strategies and policies of many countries in the field of the use of innovative technologies in the investigation of crime.

In addition, the article by Khan et al. (2021) revealed to the author the need for further implementation of machine learning programs in digital forensics in Ukraine.

The study also took into account the work of Raina (2020) in the field of confidentiality and integrity to include intelligence in the digital forensic examination. Particular attention during the writing of the article was focused on the scientific achievements of Baryshnikov and Chervyakov (2018) in the field of the need to use unmanned aerial vehicles during the inspection of the scene. In the same field, the work of Negrebetsky (2021) on the functions and possibilities of using biometric technologies in criminology has been studied.

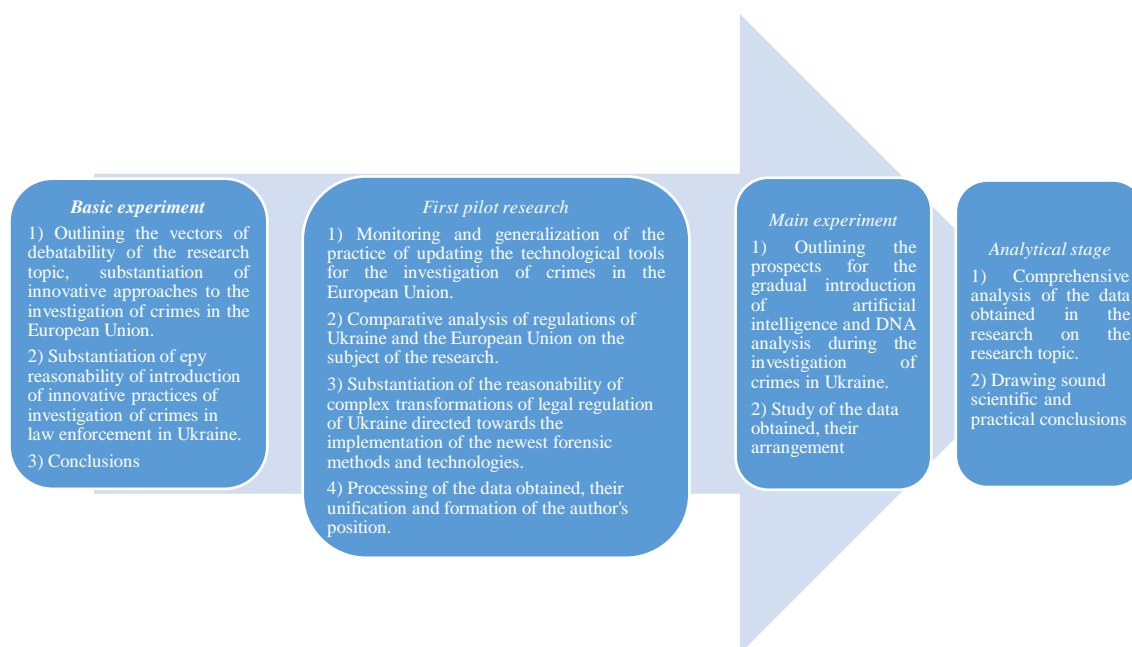
In the scientific work of Shevchuk (2020), used in the article, the importance of prospects and innovations in the field of forensic science research is emphasized. This work helped to track the transformation of the main properties of the innovative forensic product: innovation (novelty), objectivity, subjectivity, purposefulness, demand, implementation in practice, efficiency.

Active research of certain aspects of the author's chosen topic confirms the fact that the use of forensic equipment should cover all activities (investigative, judicial, expert, prosecutorial, legal, investigative, operational and

investigative, etc.), which takes into account the trend of expanding forensic knowledge in legal practice. Therefore, it is urgent to conduct research on new criteria of scientific research.

## Methods

The study tested a set of practical and general methods of scientific knowledge, which is reflected in the consistently presented material of the article. The research design, which provides for a gradual use of methodological tools for the expression of author's positions and conclusions is shown in Figure 1.



**Figure 1.** The research design. Source: authors.

The leading method of scientific research was observation, which allowed finding out and confirming the latest innovative technologies for the investigation of crimes in the European Union. This method allowed to reveal the leading problems of law enforcement agencies of Ukraine in the investigation of crimes with digital elements; features of new technological solutions in the studied area on the territory of the European Union; legal policy concepts and reform vectors of the European Union to ensure the most effective investigation of crimes and prevention. The observation method also allowed to choose a vector of promising reforms for law enforcement agencies in Ukraine in order to ensure a balance of testing positive European practices and taking into account the national realities of crime investigation. The method of observation was included as an integral part of the experimental procedure, and its results were

interpreted in the article taking into account the need for further scientific research.

The main hypothesis of the study is the statement that certain methods of forensic research, tested in the EU in the context of digitalization, can be actualized in the framework of Ukraine's European integration only in fragments.

The case study and statistical methods of collecting and summarizing information were used to study the materials of criminological research. These methods also served as a basis for systematizing the practice of law enforcement agencies that fight crime in Ukraine and the European Union.

The inductive method helped to generalize the main factors of the impossibility of fully adapting European innovation practices in Ukraine. The

method of synthesis contributed to the formulation of new provisions, theoretical conclusions, proposals and practical recommendations in the field of effective investigation of crimes, provided opportunities to identify and summarize the relevant criminological approaches. The comparative legal method allowed to study the positive experience of investigating crimes in other jurisdictions in order to further substantiate the reasonability and further effectiveness of the adaptation of positive foreign experience in Ukraine.

The method of interpretation of international and national legal acts in the field of regulation of methodologies and techniques for the investigation of criminal acts was also used in the process of writing the article. The method of legal modelling was used in the search for necessary and urgent legislative innovations in order to ensure the greatest compliance of national legal regulation with criminological innovations, as well as the latest trends in the European space and the transformation of social relations.

The reliability of the obtained results, the soundness of conclusions and recommendations in law enforcement practice are confirmed by studying a sufficient number of primary documents that form the information background for identifying statistical patterns, scientific understanding of the problem and modelling the most optimal ways to solve it. This research involved 36 sources, which were analyzed and served as a stable basis for the author's conclusions and proposals in the field under study.

## Results

Digital systems, as well as information and communication technologies have become critical in all areas of economic activity in Europe and beyond. Internet access and the uninterrupted information flow now underlie the day-to-day functioning of societies. The European Union pays more and more attention to the peculiarities and innovative approaches in the investigation of corruption crimes and crimes committed by organized groups. To date, the European Community has joined forces to develop and implement various international initiatives aimed at strengthening the law enforcement capacity of foreign governments in the fight against the growing link between crime and corruption. Moreover, multilevel work is under way to strengthen the international

network of laws and conventions against corruption, banditry and international organized crime, thus demonstrating the real value of cooperation built over the years.

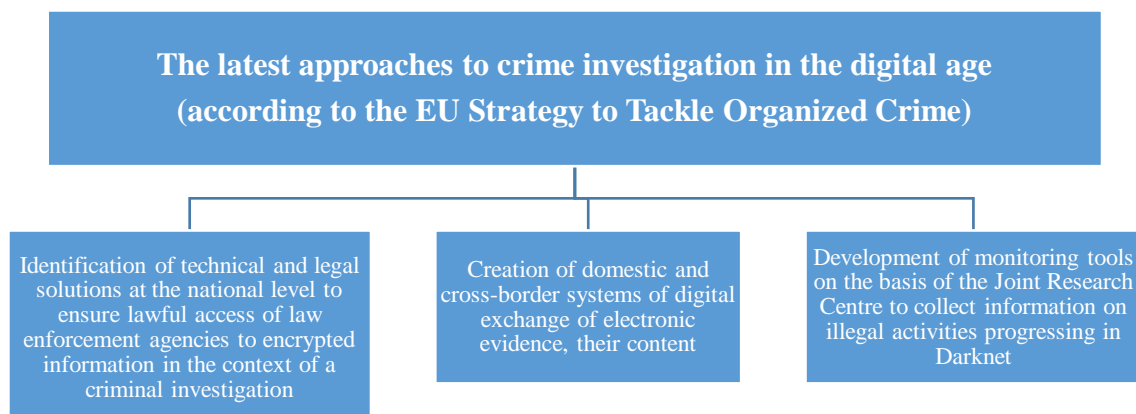
For example, the Criminal Law Convention on Corruption (Council of Europe, 1999), has become a very important tool aimed at the coordinated criminalization of a large number of acts of corruption. It also provided for additional criminal law measures and improved international cooperation in the prosecution of corruption offenses. The Convention established enhanced international cooperation (mutual assistance, extradition and provision of information) in the investigation and prosecution of corruption offenses. However, given the latest forensic approaches and the complication of criminal activities with an innovative component, this document is gradually becoming archaic and needs a fresh view of cross-border investigation of crimes.

Today, effective law enforcement is a necessary tool to ensure the reliability of anti-corruption efforts and break the cycle of impunity both worldwide and in the EU. This led to the transformation of legal regulation in this area in Europe. On April 14, 2021, the European Commission presented a new EU Strategy to Tackle Organized Crime (European Union, 2021). The new strategy is part of the EU Security Union Strategy, European Union (2020), which aims to protect European citizens from terrorism, organized crime and ensure the effective investigation of crimes. This document is also largely based on Europol's 2021 Report (Europol, 2021).

The strategy addresses the threat posed by organized crime to European citizens, public institutions and the economy as a whole. The situation is exacerbated by the ability of organized groups to adapt quickly to the changing socio-economic environment. For example, some organized criminal groups in the EU made money on the COVID-19 pandemic by selling counterfeit vaccines (RFI, 2021). At the same time, one of the most resonant examples of coordination of inter-state crime investigations in the EU is the case of EncroChat. In 2020, French and Dutch police, with the assistance of Europol, conducted an extensive pan-European investigation, during which the forces managed to break the EncroChat-encrypted communication system used by gangs and other criminals (Covington Alert, 2021). This cooperation was also a driving factor in reviewing the specifics of the investigation of

crimes in the modern conditions. In turn, the above-mentioned Strategy for Combating Organized Crime identified guiding principles in

the investigation of crimes, which are shown in Figure 2.



**Figure 2.** Leading guidelines in the investigation of crimes in the EU (based on the results of the author's analysis of the EU Strategy to tackle Organized Crime 2021-2025)

At the same time, innovative approaches to the investigation of crimes in the EU also have more specific examples of less complex methods and approaches. Due to the fact that a crime can be committed in seconds or minutes, these critical moments generate valuable information for the court. Everything from blood spatter to defects caused by bullets must be carefully and thoroughly documented. At the same time, the control or integrity of the crime scene depends on a large number of factors, therefore, the collection and further processing of evidence from the crime scene becomes especially important.

Big data, along with algorithms and machine learning, has become a central theme in intelligence, security, defense, counterterrorism, and criminal policy, as computers help the military find targets, and intelligence services justify mass surveillance of public telecommunications networks. The following entities are increasingly using new tools: (1) intelligence agencies; (2) law enforcement agencies; (3) criminal courts and probation commissions. The 3D scanning and reality imaging increasingly provide the detailed documentation needed by investigators to analyse crime scenes. By storing information digitally, forensic investigators can view even the smallest details, share that information with team members, and return to the virtual crime scene again and again to evaluate the evidence.

The unmanned aerial vehicles or drones used by the military for many years are becoming more common in law enforcement. Many departments use them to monitor or gather evidence. Others

use them to photograph accident scenes and even to control the crowd. Drones are also useful for other areas of law enforcement, as they can monitor penitentiaries and track fugitives (European Commission, 2018).

Moreover, a qualitative update of forensic crime investigation mechanisms occurs almost daily and has tremendous results. European law enforcement agencies are increasingly using artificial intelligence for the most efficient and fast processing of digital data. Many surveillance cameras have been installed at railway stations, commercial facilities and in cities to prevent crime. However, with the increase in the number of cameras, the amount of video data has also become significant. This makes it virtually impossible for law enforcement agencies to track suspicious behavior and detect crime manually. Artificial intelligence ("AI") is used to solve this problem in the fight against crime.

AI supports remote monitoring around the clock, 365 days a year, improving the accuracy of video data analysis, allowing real-time detection and reporting of suspicious activity. Surveillance cameras, which were mainly set up to record and acted as a deterrent to crime, can now be used to predict, detect and prevent crime.

Moreover, police services around the world are actively working to use artificial intelligence to analyse video and investigate criminal cases, moving toward predictive crime detection and prevention based on the concept of proactive rather than reactive crime control. Fujitsu has developed a behavioral analysis technology called Actlyzer to solve the problem of

introducing artificial intelligence to prevent crime. Actlyzer recognizes complex behavior from several basic actions or movements without forcing AI to study large amounts of video data (Fujitsu, 2020).

With this technology, AI studies in advance about 100 types of movements as basic actions: from simple actions such as walking and stopping to more complex movements and actions such as turning head to the right and raising left hand. These basic actions can be recognized with an average accuracy of 90 percent. Actlyzer's AI can detect complex patterns of behavior by analyzing combinations of types, order, and location of key actions, as well as action goals. Fujitsu presented Actlyzer at the UN Congress on Crime Prevention and Criminal Justice (Kyoto Congress) in March 2021 (The Ministry of justice, 2021). Undoubtedly, this technology has useful applications for crime prevention and video surveillance, detecting actions related to picking locks, fraud with bank transfers, shoplifting and other criminal behavior.

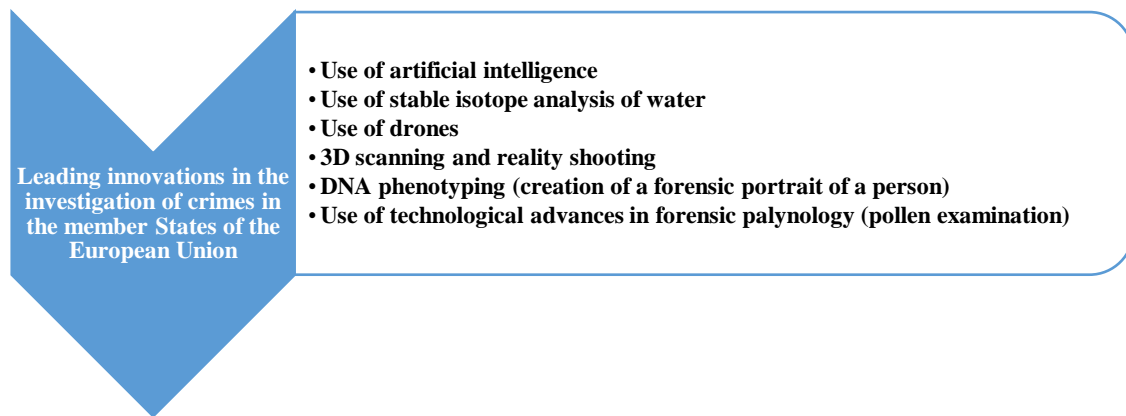
The European practice of forensic innovations is quite extensive. One hair from one's head can now determine where that person lives and where he or she has travelled. It also seems possible to determine how a person looks in terms of height, age, race, hair color and eye color. If the investigation finds dust at the crime scene left by the suspect, one can create a history of where the suspect has been for the past few weeks.

Besides, the practice of using genomics together with the computer, where a forensic portrait of a person is created on the basis of a single DNA sample, is becoming more and more common. For example, one human cell contains 23 pairs of chromosomes that encode everything related to a person: hair color, eye color, skin color, face shape, and so on. Today, computers can generate probabilities of DNA-based traits that can be combined into a common sketch. Only one

sample of DNA phenotyping is enough to determine: 1) sex — almost 100% accuracy; 2) red hair — 98% accuracy; 3) brown eyes — 93% accuracy; 4) blue eyes — 91% accuracy; 5) light and brown hair — more than 90% accuracy; 6) adult height — up to 90%; 7) black hair — almost 90% accuracy. DNA phenotyping can also make predictions that are up to 70 percent accurate for these traits: a) skin color and freckles; b) dimples; c) male baldness; d) earlobe attachment or its absence, etc.

In Germany, the practice of research using the analysis of stable water isotopes (inFranken.de, 2021) is widespread. Each pond around the world has a different percentage and combination of hydrogen and oxygen isotopes. This information is used by forensic examination. Today, different percentages of oxygen and hydrogen isotopes are measured in samples, such as human hair, to determine where a person drinks water. If you compare this hair sample with known isotopic measurements in urban drinking water from cities across the country, you can associate hair with a particular city.

Forensic scientists across Europe have been using pollen to analyse evidence for decades. Recent advances in the latest technology have made forensic palynology even more useful. In the past, a forensic palynologist compared pollen spores collected as evidence with pollen from known plant species. DNA metacoding is now used. This allows the computer to perform all analytical work from the pollen sample. Computers can even simultaneously identify multiple pollen spores of different plant species from a single sample. These innovations are used to effectively analyse the evidence stained with pollen. These technological advances in forensic palynology are in their inception, but need to be taken into account in forensic science and practice. The analysis allowed us to identify the leading new technologies used by law enforcement agencies in the investigation of crimes, which is shown in Figure 3.



**Figure 3.** Leading innovations in the investigation of crimes in the European Union (based on the results of the author's analysis set out in the article)

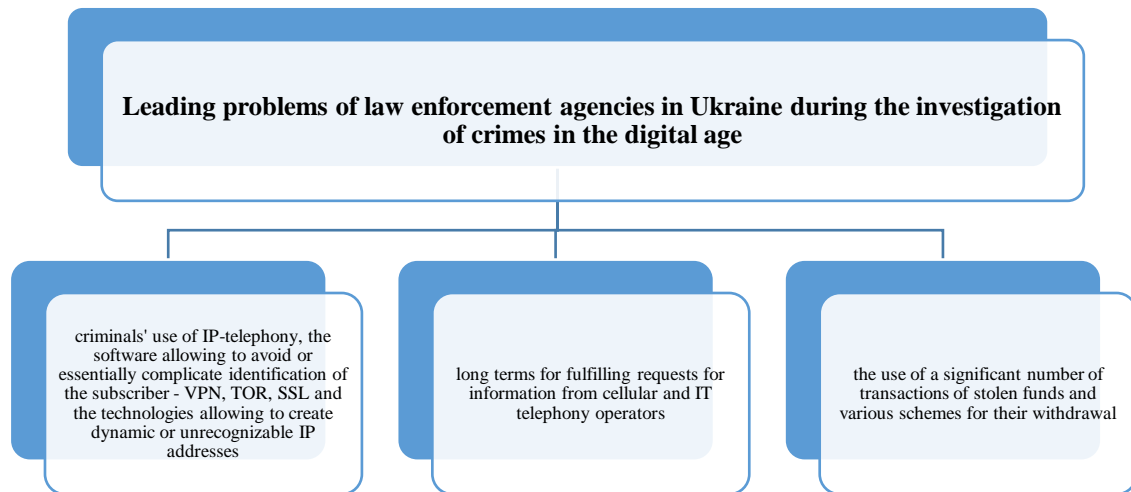
Analysis of the structure of crime in Ukraine and its dynamics shows that against the background of reducing the total number of robberies, car thefts, burglaries, robberies, facts of intentional destruction of property (arsons), the number of thefts using information and telecommunications technology increased (Cabinet of ministers of Ukraine, 2020). The increase in the number of registered crimes is also due to the peculiarities of criminal activity in this area, namely: the active development of the use of information technology, the transition of many financial transactions into the field of e-commerce; victim behavior of victims; the constant emergence of new ways of committing illegal acts; increasing anonymity of criminals — which, in turn, necessitates the improvement of mechanisms for effective investigation of crimes and combating crime as such.

The study identified the leading problems that are mostly faced by law enforcement agencies in Ukraine during the investigation of qualitatively new crimes (Figure 4).

The analysis of crime statistics showed that in 2020 there was a significant increase in cyberspace-related crimes, mostly related to the

use of electronic money (Interfax-Ukraine, 2021). At the same time, the investigation of this category of crimes is a rather difficult case for the law enforcement agencies of Ukraine. In particular, the perpetrators are characterized by the anonymity of activities, which is associated with the possibility of permanent removal of traces of the crime from the World Wide Web. Under these conditions, the investigation acquires signs of extraterritoriality and requires the involvement of operational units, among others, at the interstate level. Instead, Sweden has a unit that specializes in crimes committed through the use of virtual (electronic) money, moreover, a specialized system in the form of software creates the conditions for the relevant unit to intervene in criminal activities at different stages of the crime (ICLG, 2021). This high-tech solution would be appropriate for testing in Ukraine, however, requires the involvement of narrow specialists in addition to proper financial and technical support. It should be emphasized that the current legislation and existing methods of criminal investigation in Ukraine do not make such cooperation a prerequisite for investigative actions, despite the fact that joint actions can accelerate the search for a criminal and achieve efficiency in solving complex problems.





**Figure 4.** Leading problems of law enforcement agencies in Ukraine during the investigation of crimes in the digital age (based on the results of the author’s analysis of empirical material and observation)

Besides, the practice of involving geographic information systems in investigations, in particular, the detection and tracking of crimes, is widespread in Ukraine. The results of this practice allow asserting the increasing effectiveness of pre-trial investigation of crimes, expanding the search capabilities of law enforcement agencies. Data collected with the help of geographic information systems are now actively used for tracking and control of people and vehicles, being gradually tested in customs control processes. Modern computer technology allows comparing the model image of the territory (variable recorded reflections of the earth’s surface) with generalized criminological information collected during the investigation of the crime.

It is established that a rather progressive step of the state is the active involvement of Ukraine in the best world practices of introduction of intellectual and innovative technological solutions at the national level. In particular, 2020 in Ukraine was marked by the creation of a committee in the field of testing of artificial intelligence at the Ministry of Digital Transformation. A determinant event was publishing of the draft Artificial Intelligence Development Concept (Ministry and committee for digital transformation of Ukraine, 2020). Informatization and digitalization have changed the ways in which government agencies interact and exercise their powers. Besides, the Ministry of Justice of Ukraine announced the introduction of an innovative technological solution — Cassandra software application — in 2020". This program, thanks to the use of artificial intelligence and the latest technological innovations, will allow for the rapid detection of

the recurrence of criminal offenses by criminals (Ukrinform, 2020).

Intelligent criminal data analysis system — RICAS — was developed and implemented as part of a joint research conducted by scientists of the Kharkiv National University of Radio Electronics and specialists of the Main Directorate of the National Police in the Kharkiv region in the field of data mining. This system combines the basic and most modern methods and techniques of criminal analysis and analytical search in real time in a single space. The latest development, provided it is applied in practice, will be able to significantly increase the number of detected crimes. Moreover, the innovation can be used in the investigation of recently detected crimes, and will be useful in protracted investigations (Knure, 2019). Therefore, the use of the latest technologies of artificial intelligence in combating criminal acts in Ukraine is certainly the most relevant area of criminological research and further use in practice.

**Discussion**

The study revealed that the use of artificial intelligence is the most acceptable and already fragmentarily tested practice in the field of crime investigation in Ukraine. Gradual introduction of the newest technologies will allow providing more effective investigation of criminal acts. The moral implications of the use of many technological innovations in the investigation of crimes are actively discussed among scholars and practitioners (Horan & Saiedian, 2021). The benefits and risks are compared, but lawyers unanimously consider it appropriate to test the

use of innovative technologies in law enforcement agencies. According to scientists, this will increase the effectiveness of criminal investigations and guarantee public peace, law and order. In turn, state executive bodies should commit to initiating appropriate legislative changes and the application of innovative technologies at the regional level (King et al., 2020). The introduction of Safe City programmers in different cities of Ukraine is quite positive, which create conditions for real-time monitoring the situation on the streets and on the city's facilities (Kyiv Smart city, 2021).

As part of the scientific research, it was stated that high-tech forensic research (such as the use of DNA, including for phenotyping) cannot be used in Ukraine. This is substantiated by scientists who refer to the lack of technical capabilities, experienced specialists in these fields and the information limitations of existing databases (Perlin & Stepaniuk, 2020). Vuima (2020) argues that the creation of a DNA database will be an effective basis for the accelerated detection of criminals in the future. This position does not receive full support in the scientific community. On October 26, 2020, Draft Law of Ukraine No. 4265 "On State Registration of Human Genomic Information" (Verkhovna Rada of Ukraine, 2020) was proposed, which provides for the creation of a single domestic DNA genome database. At the same time, the proposed draft law has a number of gaps, including: 1) the requirements for the mandatory selection of genetic material do not correlate with the provisions of the Constitution of Ukraine and international regulations; 2) the conditions of storage and destruction of biological material are not outlined by the Draft Law; 3) maintaining the DNA database within the authority of one body carries significant corruption risks; 4) the Draft Law does not provide for access to the exchange of genomic information with other countries and international organizations. Given the above, the position is substantiated that even from the legislator's perspective, there is no single vector of reforms in the studied area, and the proposed innovations require significant revision (Negrebetsky, 2021).

At the same time, the forensic studies presented in the article with the latest elements are mostly innovative and cannot be fully adapted to all types of crimes in Ukraine now. There is no doubt that the interaction between all law enforcement agencies and regulatory bodies at the national level needs to be improved. Training of law enforcement agencies abroad seems to be

quite relevant. Shevchuk (2020) emphasizes the development of an algorithm for interaction with the subjects of information technology relations, foreign information technology centers for the accumulation and storage of information, obtaining electronic evidence remotely, that is using automated crime investigation methods.

Technologization and digitalization of substantive and procedural law requires changes in the organizational and legal regime of collecting electronic evidence: its detection, recording, capture, research, storage, provision and use in the investigation and consideration of a criminal case (Shepitko, 2019, p. 148). Scientists and practitioners should develop new strategies in forensic activities during the investigation: 1) crimes in the field of computer information, 2) crimes committed with the use of computer technology (Kuzmichova-Kyslenko et al., 2021; Pavliuk, 2019). The above urges in-depth forensic study of computer information and its processing as a trace of crime. Scientists have noted the importance of increasing the role of scientific knowledge based on domestic and foreign experience in the use of computer technology in the fight against crime. It is obvious that the activity of investigation of crimes will remain ineffective without fundamental research of objective laws in this subject area.

## Conclusions

While traditional types of crime remain a major concern, globalization and innovative technologies have laid the ground for new types of crime. Today, crime is reaching a qualitatively new level, using the latest developments in science, technology and digital space. Moreover, the COVID-19 pandemic has changed the world in many ways and created a comfortable background for transforming crime in 2020 just in a few months. These factors emphasize the need for a qualitative review of approaches and methods of crime investigation, taking into account innovative technologies around the world.

The analyzed foreign practice has shown that the most effective innovative technology in the effective investigation of criminal acts is the use of artificial intelligence. Moreover, computerized research, which forms a new science — digital forensics — is derived from this forensic solution. It is stated that the procedural application of digital evidence obtained through new technical solutions during the investigation of crimes remains uncertain.

This research identifies the leading innovations in the investigation of crimes in the European Union, and found that they cannot be fully adapted in Ukraine in the current conditions. Given the challenges faced by law enforcement agencies in investigating crimes in Ukraine, it is advisable to develop a comprehensive Strategy for Investigating Crimes in the Digital Age. The provisions of the Strategy should include: forensic investigation and use of electronic information, means of its processing; tactics of investigative actions aimed at obtaining electronic evidence and proper investigation of crimes; development of automated methods of crime investigation; introduction of electronic document management in criminal proceedings. The development of this content of the investigation strategy will ensure the effectiveness of the pre-trial investigation in the context of digitalization of society. The prospect of further research will also be the search for an appropriate procedural mechanism for involving narrow specialists in the process of forensic examination and crime investigation.

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