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USING BIG DATA FOR CRIME ANALYSIS AND PREDICTION

ВИКОРИСТАННЯ BIG DATA ДЛЯ АНАЛІЗУ ТА ПРОГНОЗУВАННЯ ЗЛОЧИННОСТІ

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Abstract. *The article examines the potential of Big Data technologies for crime analysis and prediction. Modern approaches to processing large datasets, as well as the application of machine learning, data mining, and artificial intelligence methods in law enforcement activities, are examined. International experience in the use of Big Data technologies for identifying crime patterns, predicting criminal activity, and supporting decision-making processes is analyzed. The main advantages and limitations of predictive models in public safety are identified. It has been established that integrating heterogeneous data sources and using advanced analytical tools improves the efficiency of crime analysis and helps develop preventive measures against criminal activity.*

Keywords: *Big Data, crime prediction, data analysis, machine learning, artificial intelligence, law enforcement, criminogenic situation, predictive analytics, information and analytical systems.*

Introduction

The rapid development of information technology, the digitalization of social processes and the constant growth in data volumes are creating new opportunities to improve the effectiveness of law enforcement agencies. One promising area is the use of Big Data technologies to analyze crime trends, identify patterns in criminal activity and predict potential offences. The use of large sets of structured and unstructured data enables a comprehensive analysis of information from various sources, including statistical reports, geospatial data, social media, closed-circuit television (CCTV) systems and public registers.

Modern methods of big data analysis enable the timely identification of trends in crime rates, pinpointing areas at heightened risk of offences, and developing predictive models to support decision-making in public safety. The use of machine learning algorithms, intelligent data analysis and artificial intelligence technologies helps to improve the accuracy of forecasting crime-related trends and optimize the allocation of law enforcement resources [1].

Big Data technologies play a central role in modern approaches to crime analysis and prevention. Thanks to its ability to analyze large volumes of diverse data, Big Data enables law enforcement agencies to identify patterns in criminal activity, predict crime, and manage operations more effectively.

Problem statement

Big Data technologies provide a framework for collecting, storing, processing, and managing massive volumes of heterogeneous data generated from multiple sources. These technologies enable organizations to extract valuable knowledge by integrating information from government agencies, businesses, industries, social networks, and other sectors, thereby supporting data-driven decision-making and improving operational efficiency.

The concept of Big Data is commonly described by the 5V model**,** which includes Volume, Velocity, Variety, Value, and Veracity**.**

Volume refers to the enormous quantities of data produced every day by individuals, organizations, digital platforms, sensors, and connected devices. Such datasets often exceed the capabilities of traditional database management systems and require distributed storage and parallel processing technologies.

Velocity describes the speed at which data are generated, transmitted, and processed. Modern information systems continuously produce real-time data streams from sources such as social media platforms, Internet of Things (IoT) devices, surveillance systems, financial transactions, and public administration services.

Variety emphasizes the diversity of data formats. Big Data environments combine structured data (e.g., relational databases), semi-structured data (e.g., XML and JSON files), and unstructured data, including text documents, images, videos, audio

recordings, and social media content. Integrating these different data types enables a more comprehensive analysis of complex phenomena.

Value represents the practical usefulness of data. Although vast amounts of information are generated daily, only a portion contributes meaningful insights. Effective Big Data analytics focuses on identifying valuable information that supports strategic planning, risk assessment, and evidence-based decision-making. In public safety and crime analysis, valuable data can improve situational awareness, optimize resource allocation, and enhance crime prevention strategies.

Veracity refers to the reliability, accuracy, and consistency of data. High-quality data are essential for developing trustworthy analytical models and producing reliable predictions. Therefore, data validation, cleansing, integration, and quality assurance are critical stages of the Big Data processing pipeline, ensuring that analytical results can support informed and effective decision-making [2].

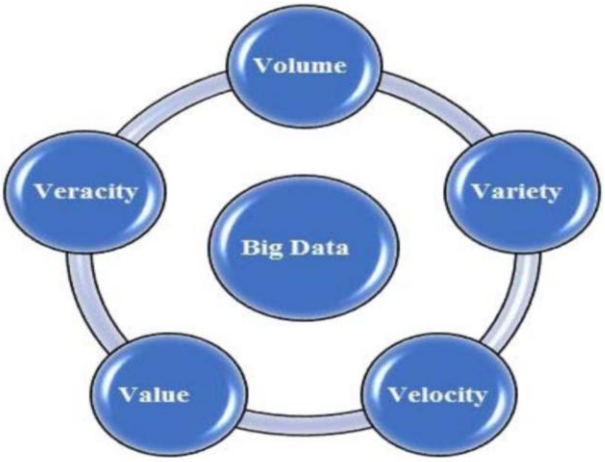


Figure 1 - Major characteristics of big data technology [2]

In the current context of society's digital transformation, there is a constant increase in the volume of information accumulated in government information systems, social media, geoinformation services and other data sources. A significant proportion of this data can be used to study crime-related processes, identify patterns in criminal activity and forecast changes in crime rates.

Traditional methods of statistical analysis of criminal data often prove insufficient for processing large, heterogeneous, and rapidly changing datasets. The limited

capacity of classical approaches to promptly identify hidden correlations among factors influencing crime necessitates the use of modern Big Data technologies, machine learning methods, and artificial intelligence tools.

Of particular relevance is the challenge of developing effective models for analyzing and forecasting crime, capable of improving the accuracy of assessing the crime situation, identifying high-risk areas in a timely manner, and supporting the decision-making process of law enforcement agencies. At the same time, the use of Big Data technologies raises a number of organizational, technical and ethical issues, in particular ensuring the confidentiality of personal data, minimizing algorithmic bias and guaranteeing the transparency of predictive models.

Consequently, a pressing research issue is to investigate the potential of applying Big Data technologies to the analysis and forecasting of crime, and to identify effective approaches to integrating these technologies into law enforcement practice, with a view to enhancing public safety and the effectiveness of crime prevention.

Analysis of recent studies and publications

The use of Big Data technologies, machine learning methods and artificial intelligence for the analysis and prediction of crime has been actively researched by the scientific community in recent years. Considerable attention is being paid to the development of models for predicting crime trends, identifying spatio-temporal patterns of criminal activity and improving the efficiency of law enforcement resource management.

One of the seminal works in the field of big data processing is the study by J. Dean and S. Hamawa [3], which proposed the MapReduce model for the distributed processing of large volumes of information, and which has become the foundation of modern big data technologies. Further developments in data analysis tools have led to numerous approaches to crime forecasting based on machine learning and intelligent data analysis.

In their paper, K. Jenga, C. Catal and G. Kar conducted a comprehensive analysis of machine learning methods for crime prediction and identified supervised learning algorithms as the most widely used, in particular decision trees, random forests, support

vector machines, and neural networks [4]. The authors emphasize the importance of using large historical datasets to improve predictive model accuracy.

In their study, Yingjie Du and Ning Ding conducted a systematic review of contemporary spatio-temporal methods for crime forecasting. The authors propose a classification of models based on the temporal and spatial scales of forecasting and demonstrate that integrating historical crime data with socio-economic and geospatial indicators significantly improves forecasting results [5].

It is worth noting the work by V. Mandalapu, L. Elluri, P. Vyas, and N. Roy, which analyzed over 150 scientific papers on the application of machine learning and deep learning methods to crime forecasting. The researchers identified the main trends in the field's development, characterized the most common datasets, and outlined promising areas for further research on the use of ensemble models and deep neural networks [6].

Despite the significant volume of research in this field, the practical implementation of Big Data technologies within law enforcement remains understudied. Further research is needed into methods for integrating heterogeneous information sources, improving the interpretability of predictive models, and ensuring that the ethical and legal aspects of using crime prediction systems are addressed. This highlights the need for further research into the use of Big Data technologies to analyses crime-related processes and predict criminal activity.

The methodological basis of the study is a set of general scientific and specialized methods that enable a comprehensive analysis of the potential of Big Data technologies for crime analysis and forecasting. The choice of research methods is determined by the interdisciplinary nature of the subject matter, which combines information technology, criminology, data analysis and artificial intelligence methods.

The study utilized methods of analysis and synthesis to summarize contemporary scientific approaches to the use of Big Data technologies in law enforcement, identify the specific features of their application, and provide a comprehensive picture of the current state of predictive criminal analytics.

Using a systematic approach, the architecture of modern crime analysis systems

has been examined, and the interrelationships between the stages of data collection, integration, storage, processing, analysis and visualization have been identified. This approach has enabled viewing the crime forecasting system as a complex of interrelated information, software, and organizational components.

The reliability of the results is ensured by the use of modern scientific research methods, the analysis of current international publications, comparisons of findings from various researchers, and a comprehensive approach to assessing the potential of Big Data technologies for analyzing and forecasting crime.

The proposed methodology has enabled the systematization of contemporary approaches to the use of big data in law enforcement, the identification of the advantages and limitations of existing technological solutions, and the outlining of promising areas for their further development and implementation in the practical work of law enforcement agencies.

Results and Discussion

Big Data technologies open new opportunities for analyzing crime and forecasting crime by processing large volumes of heterogeneous data from a wide range of sources. Such sources include official statistical databases of law enforcement agencies, demographic and socio-economic indicators, geoinformation systems, information from social networks, mobile devices and public registers.

A distinctive feature of Big Data technologies is their ability to process data characterized by significant volume, high input speed and a variety of formats. In the context of crime research, this enables a comprehensive analysis of the factors influencing the emergence and spread of criminal phenomena, as well as the identification of hidden patterns and trends in the development of the crime situation.

The process of analyzing crime using Big Data technologies comprises several key stages: data collection, pre-processing, integration of various information sources, the development of analytical models, and the generation of forecasts. During the pre-processing stage, data is cleaned, missing values are imputed, indicators are normalized, and the data are transformed into a format suitable for further analysis.

Distributed software platforms, such as Apache Hadoop and Apache Spark, can

be used to process large datasets; they ensure computational scalability and enable real-time processing. The use of MapReduce models significantly speeds up the analysis of crime statistics and enables processing on cluster computing systems.

Modern crime forecasting systems are based on data analytics, machine learning, and artificial intelligence. The most common algorithms are decision trees, random forests, support vector machines, ensemble models, and neural networks. Research shows that combining spatio-temporal crime characteristics with socio-economic and demographic indicators improves the accuracy of crime prediction.

One promising area is the creation of crime maps (Crime Mapping) and the identification of so-called 'crime hotspots' [7]. Geoinformation analysis enables the identification of areas with increased crime risk and helps optimize the allocation of law enforcement resources. Spatio-temporal forecasting models consider not only the location where a crime is committed, but also the temporal patterns of its occurrence.

The use of Big Data technologies in law enforcement offers a number of advantages, notably the ability to analyze large volumes of information in real time, improve the effectiveness of management decision-making, predict potential criminal threats, and make efficient use of material and human resources. At the same time, there are certain limitations relating to ensuring the confidentiality of personal data, the presence of algorithmic bias in models, and the need to adhere to ethical principles regarding the use of artificial intelligence technologies.

Thus, Big Data technologies represent a promising tool for analyzing and forecasting crime, enabling law enforcement agencies to operate more effectively, ensuring timely responses to crime-related threats, and facilitating the development of modern information- and analytical decision-support systems in the field of public safety. Global practice demonstrates law enforcement agencies actively implementing Big Data, artificial intelligence, and machine learning technologies to analyze crime and forecast crime. These approaches have seen the greatest development in the USA, the United Kingdom, Germany and a number of other European countries.

One of the first applications of predictive analytics in public safety was the PredPol (Predictive Policing) project in the United States of America. The system used

historical crime data, along with information on the location and timing of offences, to identify areas with a higher probability of criminal incidents. The technology was implemented by police forces in Los Angeles, Atlanta, Chicago and other US cities. Research shows that the use of predictive models has helped to improve the efficiency of police resource allocation and the implementation of a preventive approach to crime, although the effectiveness of such systems remains a subject of academic debate [8].

The City of Chicago implemented the Strategic Subject List (SSL) program, based on analyses of crime statistics, social connections, and prior-offence information, to assess an individual's risk of involvement in violent crime [9]. This system was subsequently transformed into the Crime and Victimisation Risk Model (CVRM) [10], which allows the assessment of both the likelihood of committing a crime and of becoming a victim.

In the United Kingdom, predictive analytics methods are actively used to identify areas of heightened criminal risk, analyze repeat offences and support decision-making by law enforcement agencies. In certain regions of the country, comprehensive information systems are in use that integrate police databases, social indicators, population health data, and educational data. At the same time, the UK's experience demonstrates the need to ensure algorithmic transparency and independent auditing of predictive models.

In Germany, the PRECOBS (Pre-Crime Observation System) is in use to predict serial crimes, particularly burglaries [11]. The system's algorithms analyze spatio-temporal patterns of criminal activity and generate recommendations to step up patrols in potentially high-risk areas. Similar systems are also in operation in Switzerland and some federal states of Austria.

An important area of development in modern crime prediction technologies is the use of deep learning methods and spatio-temporal analysis. International research confirms that integrating crime statistics with demographic, socio-economic, transport and meteorological data can significantly improve the accuracy of predictive models.

Alongside these positive results, international experience highlights several challenges associated with the use of Big Data technologies in law enforcement.

Among the main challenges are the risks of algorithmic bias, the reproduction of historical errors in the data, insufficient transparency in the operation of predictive systems, and issues concerning the protection of citizens' personal data. In this regard, questions regarding the ethical use of artificial intelligence, ensuring algorithmic fairness, and developing mechanisms for public oversight are becoming increasingly important.

International experience therefore shows that Big Data technologies have significant potential to improve the effectiveness of the fight against crime; however, their implementation requires a comprehensive approach that takes into account not only technical aspects but also legal, social and ethical factors.

The study found that Big Data technologies are an effective tool for analyzing the crime situation and forecasting crime. An analysis of academic publications and international experience has shown that applying methods of intelligent data analysis, machine learning, and artificial intelligence enables the identification of hidden patterns in criminal activity, spatio-temporal analysis of offences, and improved forecasting of criminal events.

It has been established that the most effective sources of information for building predictive models include statistical data from law enforcement agencies, socio-economic indicators, geospatial data, population mobility data, and data from social media and open information resources. Combining diverse sources of information improves the quality of analytical models and enables more accurate forecasts of crime levels in specific areas.

The analysis carried out has shown that the use of machine learning algorithms – in particular decision trees, random forests, ensemble methods, neural networks and spatio-temporal models – helps to improve the effectiveness of forecasting the crime situation. Recent research demonstrates that integrating historical crime data with demographic, transport and meteorological indicators significantly improves forecasting results compared with traditional statistical methods.

European countries are actively implementing Big Data, artificial intelligence and intelligent data analysis technologies to improve the effectiveness of law enforcement.

The main areas of application include forecasting crime trends, identifying organized criminal groups, analyzing cybercrime, and combating terrorism, illegal migration, human trafficking and financial crime. Unlike many other countries, the development of information and analytical systems in the European Union is carried out in accordance with strict requirements regarding the protection of personal data, the transparency of algorithms and respect for human rights.

One of the key centers for the use of Big Data technologies in law enforcement is Europol. The agency utilizes modern information and analytical platforms to integrate large datasets received from the law enforcement agencies of European Union member states. Data on international criminal networks, cyber incidents, financial transactions, the movement of persons, open-source intelligence (OSINT) and digital evidence is analyzed. The use of machine learning algorithms enables the identification of hidden links between criminal incidents, the prediction of criminal activity, and the rapid production of analytical reports for national law enforcement agencies.

An important tool for strategic analysis is the annual Serious and Organized Crime Threat Assessment (SOCTA), prepared from large datasets. Information from law enforcement agencies in EU countries, customs services, border agencies, financial institutions and other international organizations is used in the preparation of such reports [12]. The use of Big Data technologies enables not only assessing the current state of crime but also predicting the emergence of new criminal threats.

In the UK, information and analytical systems are actively used to forecast crime trends and identify areas at heightened risk of crime. Police forces use spatio-temporal analysis, geographic information systems, clustering algorithms and machine learning to analyze crime statistics. Particular attention is paid to combating violent crime, domestic violence, repeat offences and cybercrime.

In the Netherlands, one of the best-known examples of data analytics is the Criminaliteits Anticipatie Systeem (CAS) project, which uses historical crime data, socio-economic indicators, geographic characteristics, and temporal patterns to predict where crimes are most likely to occur [13]. The results are used to plan police patrol routes and preventative measures.

In Germany, the police in certain federal states use the PRECOBS (Pre-Crime Observation System), designed primarily to predict burglaries. The system operates by analysing crime patterns, the geographical proximity of crime scenes and the time intervals between criminal incidents [14]. The use of such models enables police patrols to be stepped up promptly in high-risk areas.

France, Spain and Italy are actively using big data analytics platforms to combat terrorist activities, organized crime and financial fraud. Considerable attention is paid to analyzing information from open sources, social media, banking transactions and telecommunications networks. To this end, graph analysis methods are employed to identify the structure of criminal networks and establish links between their members.

The issue of legal regulation governing the use of big data is particularly important in the European Union. Information processing is carried out in accordance with the requirements of the General Data Protection Regulation (GDPR), which sets strict rules for the collection, storage, and use of personal data [15]. Furthermore, the provisions of the European Union's Artificial Intelligence Act (AI Act) are being actively implemented; this Act sets out requirements for transparency, safety and accountability in the use of artificial intelligence systems, particularly in law enforcement.

Thus, European experience shows that the effective use of Big Data technologies in the field of crime analysis and forecasting depends not only on the level of development of information technology, but also on the existence of a modern regulatory framework, inter-agency data sharing, international cooperation and adherence to the principles of the rule of law, transparency and the protection of human rights. The experience of European Union countries can be utilized to modernize the information and analytical systems of Ukraine's law enforcement agencies, develop predictive criminal analytics, and implement modern technologies to support management decision-making.

The effectiveness of using Big Data technologies in crime analysis and forecasting depends to a large extent on the architecture of the information and analytical system. Such a system must ensure the collection, integration, storage, processing, analysis and visualization of large volumes of heterogeneous data in a manner as close to real time

as possible. Modern crime analysis systems are built on a modular architecture, ensuring scalability, flexibility, and integration with law enforcement agencies' existing information resources.

The typical architecture of a Big Data-based crime analysis system consists of several interconnected layers.

1. *Data Acquisition Layer***.** At this level, information is collected from various sources. The main sources include: the National Police's information systems; criminal case databases; court registers; CCTV data; geographic information systems (GIS); demographic and socio-economic indicators; transport systems; public registers; social media and open-source intelligence (OSINT); IoT devices and sensor networks.

At this stage, mechanisms for continuous information flow and data integration from various sources are employed.

2. *Storage Layer.* As the information varies in structure and is of considerable volume, modern distributed data stores are utilised. The main technologies include: the Hadoop Distributed File System (HDFS); NoSQL databases (MongoDB, Cassandra); data lakes; distributed file systems; and cloud data stores.

Such solutions ensure fault tolerance, scalability and the ability to process information in parallel.

3. *Data Processing Layer*. *Once* the information has been collected, it undergoes preliminary processing: data cleansing, duplicate removal, normalization, integration across different formats, anonymization of personal data, and the creation of a unified information space.

Apache Hadoop, Apache Spark, Apache Flink, and other Big Data platforms are used for distributed processing.

4. *Analytics Layer. At* this level, intelligent data analysis and predictive modelling are performed. The most commonly used methods are: cluster analysis, association analysis, time series analysis, spatio-temporal analysis, decision trees, random forests, gradient boosting, neural networks, and deep learning algorithms.

The use of these methods enables the identification of patterns in criminal activity, the prediction of the emergence of new crime hotspots, and the assessment of risk

factors.

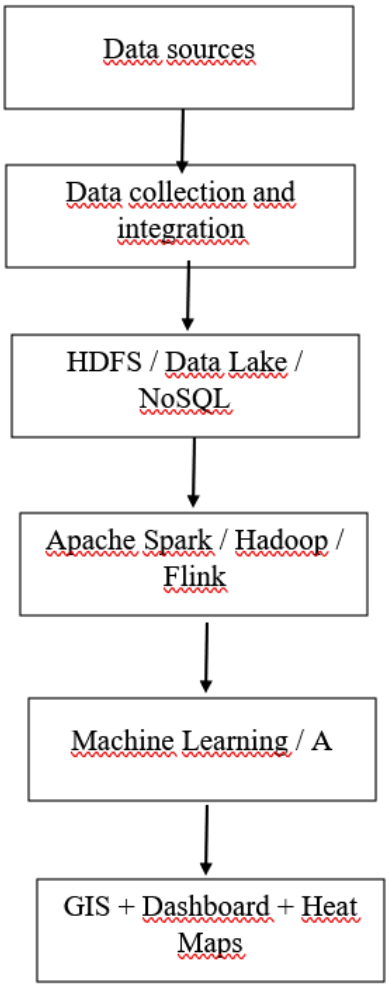


Figure 2 - The architecture of a crime analysis system based on Big Data

Source: author's development

5. *Decision Support Layer. The* results of the analysis are presented in the form of interactive dashboards, statistical reports, heat maps, crime connection graphs and geoinformation maps. Power BI, Tableau, Grafana, Kibana and specialized GIS platforms may be used for visualization.

The analytical results are used to: forecast crime trends; identify crime 'hotspots'; plan patrol routes; assess the effectiveness of crime prevention measures; and support strategic planning for law enforcement agencies.

6. *Security Layer. As* crime analysis systems handle confidential information, it is important to ensure comprehensive data protection. The main mechanisms include: user authentication and authorization; access control; data encryption; logging of user actions; monitoring of cyber threats; and ensuring compliance with the GDPR and

other regulatory requirements regarding the protection of personal data.

The proposed architecture provides a comprehensive approach to analyzing crime-related processes and lays the foundation for the development of modern information and analytical decision-support systems. The use of a modular architecture enables the integration of new data sources, the refinement of forecasting algorithms, and the adaptation of the system to changes in crime patterns and the needs of law enforcement agencies. The implementation of such systems will help to improve the effectiveness of criminal analysis, enable the timely identification of threats and optimize the use of law enforcement resources.

One of the key areas of development for Big Data technologies in law enforcement is the application of machine learning algorithms to analyze criminological data and forecast crime. The use of such algorithms enables automatic identification of hidden patterns, assessment of the impact of various factors on the crime situation, and prediction of crime likelihood based on large volumes of historical data.

The choice of algorithm depends on the task at hand, the data structure, data volume, and the required forecasting accuracy. In crime analysis, both classical statistical methods and modern machine learning and deep learning algorithms are used.

A comparative analysis shows that there is no universal algorithm for forecasting crime. The choice of model depends on the characteristics of the data under investigation, the task at hand and the available computational resources. For most practical tasks involving the analysis of criminological information, it is advisable to use ensemble algorithms, such as Random Forest or Gradient Boosting, which ensure high accuracy, are robust to noise and work effectively with large datasets [16]. For the analysis of CCTV footage, text messages and spatio-temporal patterns, the use of deep learning models is promising, as they enable the automatic identification of complex interrelationships between events and the generation of more accurate forecasts of how a crime-prone situation may develop.

The effectiveness of crime analysis and forecasting depends to a large extent on

the completeness, timeliness and reliability of the data used to build analytical models. Modern Big Data technologies enable the integration of large volumes of structured, semi-structured, and unstructured data from diverse sources. The comprehensive use of such data enables a more complete understanding of the crime situation, the identification of hidden patterns, and improved accuracy in crime forecasting.

The main source of information is statistical data compiled by law enforcement agencies. These include details of recorded criminal and administrative offences, the location and time of the offence, the offence category, the method of commission, information on suspects and victims, and the results of investigations. Such data are used to construct time series, conduct spatial analysis and train machine learning models.

Electronic court registers and the information systems of judicial authorities are an important source of information. Analysis of court rulings, case processing times, types of punishment, and recidivism enables the identification of crime trends, the assessment of the effectiveness of criminal policy, and the development of predictive models for recidivism.

Geographic Information Systems (GIS) enable the spatial analysis of crime-related processes. Such data includes the geographical coordinates of crime scenes, characteristics of the road network, transport infrastructure, residential development, public spaces, lighting levels, CCTV camera presence, and other elements of urban infrastructure. The use of GIS enables the creation of crime maps, the identification of ‘hotspots’ and the analysis of territorial patterns in the spread of criminal activity.

Indicators of socio-economic development in different areas are widely used to build predictive models. These include population size, population density, unemployment rates, average income, educational attainment, migration patterns, housing conditions, levels of urbanization and other factors that may influence crime rates. Integrating such indicators with crime statistics enables the identification of correlations between social processes and crime rates.

CCTV systems are one of the most dynamic sources of Big Data. Video feeds from city-wide cameras, transport hubs, critical infrastructure sites and public places

are used for automatic object recognition, the detection of anomalous behavior, the analysis of traffic flows and real-time monitoring of the situation.

Open-source intelligence (OSINT) includes posts on social media, news websites, forums, blogs, public web portals and other online resources. Analyzing textual information using natural language processing (NLP) methods enables the identification of potential threats, signs of radicalization, coordinated criminal activity, information campaigns, and other factors that may affect public safety.

Aggregated data on population mobility, transport flows and the use of telecommunications infrastructure can be used to study the spatio-temporal patterns of people's movements. Analyzing such data enables assessing population density in specific areas, predicting potential locations of mass gatherings, and accounting for these factors when modelling crime patterns.

In many countries, significant amounts of information are published as open data. This may include crime statistics, socio-economic indicators, transport infrastructure data, environmental characteristics, urban planning documentation and other datasets available via government open data portals. Integrating open data with criminological information facilitates the development of more comprehensive analytical models.

One of the key features of Big Data technologies is their ability to integrate diverse data into a single information environment. Combining crime statistics, geospatial information, socio-economic indicators, CCTV data, open sources and sensor networks enables the creation of multidimensional crime analysis models. This enables improved forecasting accuracy, the identification of new crime trends in a timely manner, and support for management decision-making. Thus, modern crime analysis systems integrate various Big Data sources, enabling a comprehensive study of crime-related processes and creating the conditions for building highly accurate forecasting models. Combining structured, semi-structured, and unstructured data within a single information environment enhances law enforcement effectiveness, optimizes resource use, and ensures timely responses to potential threats to public safety.

The rapid development of artificial intelligence (AI) technology is significantly expanding the potential for using big data to analyze and predict crime. Whilst

traditional information and analytical systems were primarily concerned with the collection, organization and statistical analysis of criminological data, modern AI systems can automatically identify hidden patterns, forecast crime trends and support real-time decision-making in management.

One of the most promising areas is the use of machine learning algorithms to build predictive models of crime. Such algorithms analyze historical data on offences, the spatial and temporal characteristics of crimes, socio-economic indicators, demographic factors and other parameters that influence the crime situation. Based on the identified patterns, the models predict the likelihood of crime in specific areas or time intervals.

Deep learning methods play a key role in analyzing unstructured information, including text documents, digital images, CCTV footage, and audio data. The use of convolutional neural networks enables the automatic detection of suspicious behavior in video footage, whilst recurrent neural networks and transformer models effectively analyze time series and textual information.

At the same time, the wider use of artificial intelligence technologies in law enforcement raises several important issues. First and foremost, these include ensuring algorithmic transparency, explaining predictive outcomes, preventing discrimination against specific social groups, protecting personal data, and adhering to international ethical standards governing the use of artificial intelligence.

A promising area for Ukraine is the creation of a single, integrated information and analytical platform that will bring together data from the National Police, the judiciary, the Border Guard Service, customs authorities, local authorities and open government registers. The integration of Big Data, artificial intelligence technologies, and geographic information systems will lay the foundations for a modern predictive criminal analytics system capable of enhancing the effectiveness of the fight against crime, optimizing the use of law enforcement resources, and improving public safety.

Conclusions

This article explores the potential applications of big data technologies for analyzing and forecasting crime. It has been established that the use of large data sets, modern methods of intelligent analysis, machine learning and artificial intelligence can

significantly improve the effectiveness of identifying patterns in criminal activity, assessing the crime situation and forecasting potential criminal threats.

An analysis of current scientific research and international experience has shown that Big Data technologies are being actively implemented by law enforcement agencies worldwide to optimize resource allocation, identify high-risk areas, and support decision-making in public safety. It has been established that the most promising approaches involve spatio-temporal analysis, geographic information systems, machine learning algorithms, and predictive models that integrate diverse information sources.

At the same time, it has been identified that the implementation of Big Data technologies in the field of crime forecasting is accompanied by a number of challenges relating to ensuring the confidentiality of personal data, minimizing algorithmic bias, increasing the transparency of models, and complying with ethical and legal standards governing the use of information technologies.

It is important to continue working to establish standards for the use of Big Data that meet citizens' privacy and security requirements. Big Data technologies open up new opportunities for analyzing and preventing crime. Their use enables improved forecasting accuracy, more effective utilization of law enforcement resources, and enhanced citizen safety. However, for the full implementation of Big Data in crime analysis, technical, ethical and organizational challenges must be overcome. The development of new technologies and international cooperation will enable this tool to be used as effectively as possible.

The results confirm the significant potential of Big Data technologies to enhance the effectiveness of law enforcement agencies and to create modern information- and analytical decision-support systems. A promising area for further research is the development of adaptive crime prediction models that leverage national information resources, as well as the integration of artificial intelligence technologies to automate the analysis of crime-related data and the formulation of preventive strategies to ensure public safety.

References:

1. Горелов Ю., Кобзев І. Використання технологій Big Data для аналізу злочинності / Безпека у кіберсфері : зб. матеріалів Міжнарод. наук.-практ. конф. (м. Кам'янець-Подільський, 28 трав. 2025 р.) / МВС України, Харків. нац. ун-т внутр. справ; Нац. акад. правових наук України; Організація з безпеки та співробітництва в Європі. – Кам'янець-Подільський : ХНУВС, 2025. – – с. 85-87. URL: https://dspace.univd.edu.ua/handle/123456789/23491

2. M. N. I. Sarker, M. Wu and M. A. Hossin, "Smart governance through bigdata: Digital transformation of public agencies, " 2018 International Conference on Artificial Intelligence and Big Data (ICAIBD), Chengdu, China, 2018, pp. 62-70, URL: https://doi.org/10.1109/ICAIBD.2018.8396168.

3. Dean J., Ghemawat S. MapReduce. Communications of the ACM. 2008. Vol. 51, no. 1. P. 107–113. URL: https://doi.org/10.1145/1327452.1327492

4. Jenga, K., Catal, C., & Kar, G. (2023). Machine learning in crime prediction. Journal of Ambient Intelligence and Humanized Computing, 14(3), 2887–2913. URL: https://doi.org/10.1007/ s12652-023-04530-y

5. Du Y., Ding N. A Systematic Review of Multi-Scale Spatio-Temporal Crime Prediction Methods. ISPRS International Journal of Geo-Information. 2023. Vol. 12, no. 6. P. 209. URL: https://doi.org/10.3390/ijgi12060209

6. Crime Prediction Using Machine Learning and Deep Learning: A Systematic Review and Future Directions/ V.Mandalapu et al.IEEE Access. 2023. P.1. URL: https://doi.org/10.1109/access.2023.3286344

7. Kalantari, Mohsen and Ahadi, Leila and Ghezelbash (2026). Somaye, Crime Mapping: A Scientometric and Bibliometric Analysis. URL: http://dx.doi.org/10.2139/ssrn.6388110

8. What Is Predictive Policing and How Does It Impact Justice? | American Military University (AMU).American Military University. URL: https://www.amu.apus.edu/area-of-study/criminal-justice/resources/what-is-predictive-policing/

9. Strategic Subject List – Historical. City of Chicago | Data Portal | City of Chicago | Data Portal. URL: https://data.cityofchicago.org/Public-Safety/Strategic-

Subject-List-Historical/4aki-r3np/about_data

10. Crime and Victimisation Risk Model (CVRM). Chicago Police Department. URL: https://www.chicagopolice.org/wp-content/uploads/FACT-SHEET-Crime-and-Victimization-Risk-Model-1.pdf

11. Scoring and prediction | LogObject.LogObject | Software für mobiles dynamisches Prozessmanagement. URL: https://logobject.com/en/solutions/public-safety-and-authorities/process-case-management/scoring-and-prediction

12. Artificial Intelligence Act: MEPs adopt landmark law | News | European Parliament. URL: https://www.europarl.europa.eu/news/en/press-room/20240308IPR19015/artificial-intelligence-act-meps-adopt-landmark-law

13. Politie stopt met algoritme Criminaliteits Anticipatie Systeem.NJB | Nederlands Juristenblad. URL: https://www.njb.nl/nieuws/politie-stopt-met-algoritme-criminaliteits-anticipatie-systeem/

14. Scoring and prediction | LogObject.LogObject | Software für mobiles dynamisches Prozessmanagement. URL: https://logobject.com/en/solutions/public-safety-and-authorities/process-case-management/scoring-and-prediction

15. Загальний регламент про захист даних (GDPR) - GDPR-Text.com.GDPR-Text.com - GDPR Text, Translation and Commentary. URL: https://gdpr-text.com/uk/

16. How to Decide Between Random Forests and Gradient Boosting - MachineLearningMastery.com. URL: https://machinelearningmastery.com/how-to-decide-between-random-forests-and-gradient-boosting/

Анотація. *У статті досліджено можливості використання технологій Big Data для аналізу та прогнозування злочинності. Розглянуто сучасні підходи до обробки великих масивів даних, особливості застосування методів машинного навчання, інтелектуального аналізу даних та штучного інтелекту у сфері правоохоронної діяльності. Проаналізовано зарубіжний досвід використання технологій Big Data для виявлення криміногенних закономірностей, прогнозування злочинної активності та підтримки процесів прийняття управлінських рішень. Визначено основні переваги та обмеження застосування прогнозних моделей у сфері забезпечення громадської безпеки. Встановлено, що інтеграція різнорідних джерел інформації та використання сучасних аналітичних інструментів сприяють підвищенню ефективності аналізу криміногенної ситуації та формуванню превентивних заходів протидії злочинності.*

Ключові слова: *Big Data, прогнозування злочинності, аналіз даних, машинне навчання, штучний інтелект, правоохоронна діяльність, криміногенна ситуація, прогнозна аналітика, інформаційно-аналітичні системи.*

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