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Fighting crime through crime analysis: The experience of using innovative technologies in European Union countries

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Abstract

The aim of this article was to study innovative technologies and tools in the context of the introduction of crime analysis tools used in the countries of the European Union EU, to the Ukrainian practice. The research involved the following methods: statistical analysis, induction and deduction, classification and comparison. The study described the legally enshrined powers of the Ukrainian police with respect to information and analytical activities. Current trends in the number of criminal offenses committed in Ukraine under separate articles were determined, and these trends were compared before and after the adoption of the Law of Ukraine "On National Police". The introduction of the latest means of criminal analysis into Ukrainian practice was also studied. The conclusions established that the technologies used by EU countries can increase the effectiveness of law enforcement agencies in Ukraine, provided that certain adaptation measures are implemented. Moreover, the results obtained during the research can be used by law enforcement agencies to improve and optimize crime analysis.

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Keywords: criminal analysis; innovative technologies; tool platforms; analytical tools; crime fighting.

La lucha contra la delincuencia mediante el análisis de la delincuencia: la experiencia del uso de tecnologías innovadoras en los países de la Unión Europea

Resumen

El objetivo de este artículo fue estudiar tecnologías y herramientas innovadoras en el contexto de la introducción de las herramientas de análisis de delitos utilizadas en los países de la Unión Europea UE, a la práctica ucraniana. La investigación involucró los siguientes métodos: análisis estadístico, inducción y deducción, clasificación y comparación. En el estudio se describieron los poderes legalmente consagrados de la policía ucraniana con respecto a las actividades de información y análisis. Se determinaron las tendencias actuales en el número de delitos penales cometidos en Ucrania en virtud de artículos separados, y se compararon dichas tendencias antes y después de la aprobación de la Ley de Ucrania «Sobre la Policía Nacional». También se estudió la introducción de los últimos medios de análisis criminal en la práctica ucraniana. En las conclusiones se estableció que las tecnologías utilizadas por los países de la UE pueden aumentar la eficacia de los organismos encargados de hacer cumplir la ley en Ucrania, siempre que se apliquen determinadas medidas de adaptación. Por lo demás, los resultados obtenidos durante la investigación pueden ser utilizados por los organismos encargados de hacer cumplir la ley para mejorar y optimizar el análisis del delito.

Palabras clave: análisis criminal; tecnologías innovadoras; plataformas de herramientas; herramientas analíticas; lucha contra la delincuencia.

Introduction

The adoption of the Law of Ukraine "On the National Police" (Verkhovna Rada of Ukraine, 2022a) became a powerful impetus for restructuring law enforcement agencies. One of the main goals of the transformations triggered by the adoption of this Law is improve the effectiveness of the police through the use of European experience and practice. The main vectors for transformations are the use of the latest information technologies, as

well as analytical tools in the fight against various types of crime (Knyazev, 2018; Hayward and Maas, 2021; Mastrobuoni, 2020).

The transformations outlined above are characteristic of the introduction of the Intelligence Led Policing (ILP) model — an analytics-based model of policing (OSCE, 2017). This model involves pre-emptive actions by using certain analytical tools, therefore it is a necessary alternative to the existing way of policing, which is based on responding to incidents that have already occurred (Tishchenko and Belik, 2019; Burcher and Whelan, 2019; Lewandowski *et al*., 2018).

An analytical tool is supposed to mean the methods, certain technical means or software used for carrying out the necessary analytical operations (Strukov *et al*., 2021). The arrangement and study of such tools contributes to the expansion of the tools available to law enforcement agencies in terms of predicting, preventing and detecting crimes.

This is especially relevant in view of the various crisis occurrence and the increasing crime rate (Bossong and Bothe, 2018; Schmid, 2018; Shaw, 2019). Besides, the need to study and use the latest tools of crime analytics is determined by the globalization processes and integration of the EU experience into Ukrainian practice, including the activities of law enforcement agencies (Lykhova, 2019; Frantsuz, 2020) with the aim to increase their effectiveness and compliance with European standards.

In view of the foregoing, the aim of this research is to study and arrange innovative technologies and tools in the context of the introduction and adaptation of crime analytics tools used in EU countries into Ukrainian practice.

The aim involved a number of the following research objectives:

- describe the main powers of the police in the field of information and analytical support, as well as legislative aspects regarding the use of technical devices, technical means and specialized software by the police in Ukraine;
- study statistics on crimes in Ukraine and their dynamics;
- identify and describe the latest analytical tools used in criminal analysis to investigate crimes;
- outline the features of some tool systems used in the EU countries regarding the criminal analysis conducted by law enforcement agencies;
- study the practice of introducing the latest tools of criminal analysis and their adaptation to Ukrainian realities.

1. Literature review

Knyazev (2018) defines intelligence (or criminal) analytics as the process of processing information, including its collection, assessment, analysis, etc., regarding suspects, criminals or their groups (organization). The main advantage of crime analytics is enabling law enforcement agencies to act proactively, that is, providing their ability to prevent planned crimes, and not only to investigate committed crimes.

The researchers study a number of models of predictive policing, in particular, the ILP model, which is successfully used in some EU countries and the USA. This model is based on analytics and involves the application of international standards, as well as methods of intellectual analysis in order to prevent and detect crimes (Strukov *et al*., 2021).

Vidović (2022) expands the definition of the ILP model, noting that this model is based on proactive actions and focuses on the regular collection and assessment of information through qualitative analysis, which is transformed into the strategic and operational analysis products, which form the ground for decision-making by law enforcement agencies.

Korniienko *et al*. (2021) provide the following definition of ILP: it is an organizational model and management philosophy in which criminal analysis and criminal intelligence are key tools to achieve the goal by applying an objective and effective decision-making mechanism to counter and prevent crime through strategic management and effective functioning of the law enforcement agencies, as well as methods aimed at neutralizing crimes that are particularly dangerous for society. Sullivan *et al*. (2020) indicate that ILP is highly popular because it provides a framework for efficient use of limited resources.

Tishchenko (2019) notes that criminal analysis plays the key role in the ILP model, so it involves the use of the latest information technologies and tools for data collection, assessment and analysis. Information processing results in the transformation of disparate data sets into effective analytical products that contribute to informed decision-making by law enforcement agencies.

A number of studies deal with various tools of criminal analysis developed on the basis of the ILP and similar models. Mediná *et al*. (2018) identified the features of a number of tools, where Maltego was the first and one of the most popular. This tool makes it easier to search and obtain information about individuals and organizations that can be found in a variety of open and public sources.

Simmler *et al*. (2022) distinguish IBM i2 Analyst's Notebook tool as an additional advanced technology for data analysis used by some police departments in Switzerland. Federico and Thompson (2019) write on the

function of Palantir Gotham in view of the purposes of conducting criminal analysis by special agents and investigative analysts in the criminal investigations of the US Internal Revenue Service.

In contrast to the studies mentioned above, Castets-Renard (2021) casts doubts about the effectiveness of using the latest tools of crime analytics. The researcher focuses on the shortcomings in the use of particular platforms.

The literature review determines the need for a detailed survey of the features of various tools that support crime analytics, as well as to determine its effectiveness based on the analysis of actual data regarding the change in the crime rates.

2. Methods and materials

2.1. Research design

The research is comprehensive, this is why it is divided into several interrelated and coordinated stages. The first stage of the research involved establishing the main powers of the police in the field of information and analytical support by analysing the legislative framework, namely the Law of Ukraine "On the National Police". The legislative aspects regarding the use of technical devices, technical means and specialized software by the police in Ukraine are outlined.

The second stage of the study describes statistics on criminal offences in Ukraine and their dynamics. The period from 2013 to 2020 and the following articles of the Criminal Code of Ukraine (Verkhovna Rada of Ukraine, 2022b) were covered: Murder, Illegal confinement or abduction of a person, Trafficking in human beings, Theft, Robbery, Gangsterism, Rape, Smuggling, Gambling business, Sham business, Obstruction of legitimate business activity, Misappropriation, Evasion of taxes, VAT evasion, Fraudulent bankruptcy, Legalization (laundering) of criminally obtained money and other property, Violation of law on budget system of Ukraine, Financial fraud, Illegal privatization of public or communal property.

The change in the number of crimes before and after 2015 (the year when the Law of Ukraine "On the National Police" was adopted) is compared. The position of Ukraine and its neighbouring countries in the ranking of countries by the crime rate provided on Numbeo was determined.

The third stage provided for the classification and brief description of tools of crime analysis through the literature survey. The most common analytical tools used in crime analysis for the investigation of crimes are described.

The fourth stage contains a description of the features of some tool systems used in the EU countries regarding the activities of law enforcement agencies in the field of crime analytics. IBM i2 Analyst's Notebook, Maltego, Palantir Gotham and police systems were considered. Besides, the practice of introducing the latest means of crime analysis in Ukraine, in particular the RICAS system, was studied, as well as the possibilities of adapting European systems to Ukrainian realities.

2.2. Information background

The information background of the research is academic periodicals of Ukraine and other countries, legislative acts, in particular the Law of Ukraine "On the National Police" (Verkhovna Rada of Ukraine, 2022a), the Criminal Code of Ukraine (Verkhovna Rada of Ukraine, 2022b), data on the ranking of countries according to the Crime Index, which are publicly available on Numbeo, and information from the official sites of IBM, Maltego, Palantir, UNICRI and RICAS.

2.3. Research methods

The following scientific methods were used during the study:

- statistical analysis — to study the dynamics of the number of criminal offences for the period from 2013 to 2020 under individual articles of the Criminal Code of Ukraine;
- induction and deduction — to establish the relationship between the crime rate and the adoption of the Law of Ukraine "On the National Police";
- ranking — in the course of studying the positions of different countries in the Numbeo ranking for the Crime Index;
- comparison — to compare different platforms that offer tools for conducting crime analysis.

3. Results

3.1. The main powers of the police in the field of information and analytical support: legislative aspects of the use of technical devices, technical means and specialized software by the police in Ukraine

With the adoption of the Law of Ukraine "On the National Police", the structure of the country's law enforcement agencies began its transformation in accordance with European standards and principles. The main feature

of the transformations is the orientation of policing to the prediction of offences and their early prevention through the use of the latest technologies and tools, in particular, crime analytics tools.

Article 25 of the above-mentioned Law determines the powers of the police to carry out information and analytical activities. In a generalized form, the police carry out the following measures within the scope of such activities: creation and use of registers and databases of public authorities, carrying out work related to the search and analysis of necessary information, interaction with other public authorities regarding the exchange of information, provision of data on conscripts, persons subject to the draft and reservists. Besides, the police can create their own registers and databases (Verkhovna Rada of Ukraine, 2022a).

The Law "On the National Police" also provides a list of devices, technical means, as well as software, which can be used by the police in order to perform their duties established by the law. Figure 1 provides a list of these tools.

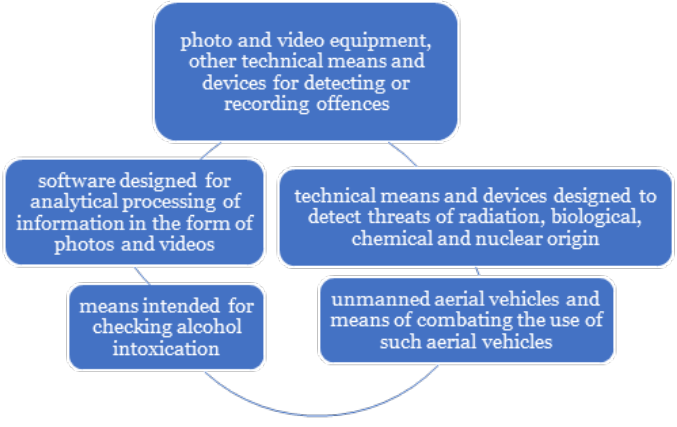

Figure 1. Devices, technical means and software that can be used by the police in order to perform their duties (About the National Police, 2022).

Statistical and analytical information regarding the measures taken to prevent and combat crimes must be made public on relevant web portals by the heads of territorial police agencies for the purpose of public control over policing.

3.2. Statistical data and dynamics of the number of crimes committed in Ukraine

In view of the legislative aspects outlined above regarding the information and analytical activities of the Ukrainian police, it can be concluded that the efficiency of law enforcement agencies should increase with the adoption of the Law "On the National Police", in particular through the use of innovative analytical tools. Therefore, it is interesting to study the dynamics of the number of crimes committed in Ukraine under separate criminal articles (Verkhovna Rada of Ukraine, 2022b) before and after the adoption of the Law (Figure 2).

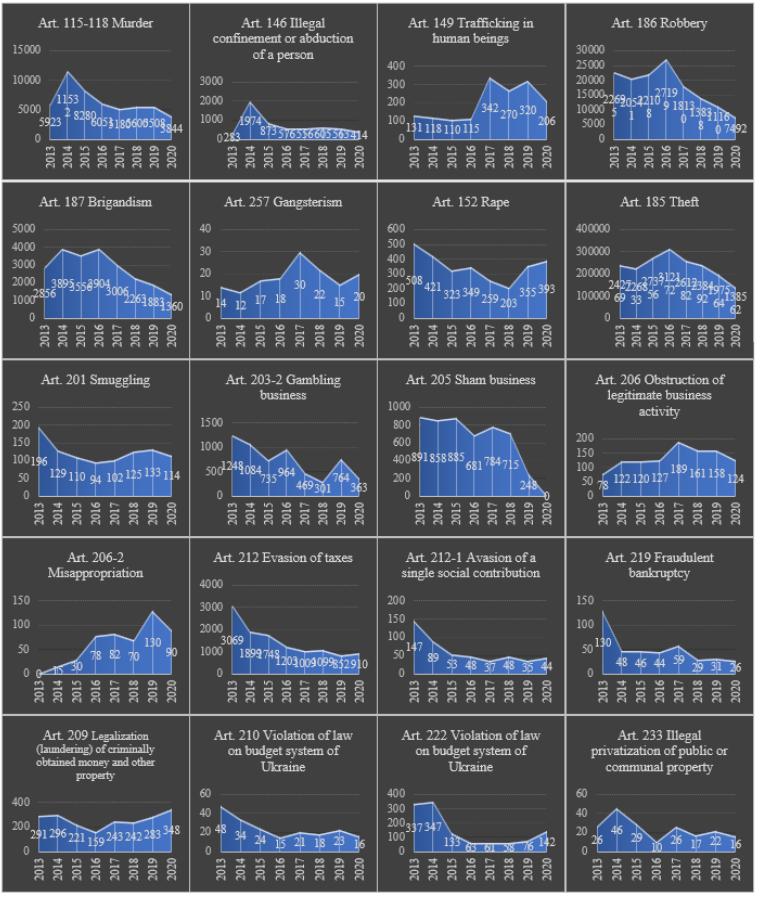

Figure 2. Dynamics of the number of crimes committed in Ukraine (SLOVO I DILO, 2021).

Analysing the information presented in Figure 2, it can be noted that the following crimes are the most common in Ukraine: theft, robbery, brigandism, murder, tax evasion, illegal confinement or abduction of a person. After 2015-2016, there is mostly a tendency towards the reduction in the number of such offences, which may indirectly indicate the effectiveness of the introduction of the latest information technologies and means of combating crime.

According to Numbeo (2021), Ukraine ranks 54th (out of 135 countries) in the world according to the Crime Index. In Europe, Ukraine is in the top three most dangerous countries (out of 41 for which the Index is defined): it ranks third after Belarus and France (Table 1).

Table 1. Ranking of European countries according to the Crime Index (the first 15 countries with the highest crime rates) (Numbeo, 2021).

Rank	Country	Crime Index	Safety Index
1	Belarus	60.27	39.73
2	France	49.20	50.80
3	Ukraine	48.28	51.72
4	Sweden	47.20	52.80
5	Moldova	46.56	53.44
6	United Kingdom	45.26	54.74
7	Ireland	45.02	54.98
8	Italy	44.37	55.63
9	Belgium	44.17	55.83
10	Greece	44.14	55.86
11	Bosnia And Herzegovina	43.01	56.99
12	Albania	41.64	58.36
13	Montenegro	41.61	58.39
14	Russia	40.13	59.87
15	Malta	38.93	61.07

Ukraine's neighbours in the mentioned ranking are such EU countries as France and Sweden, however, the result — the third country in Europe in terms of crime rate — cannot be satisfactory. Therefore, the public authorities of Ukraine need to strengthen their efforts to prevent and prevent criminal activity. A positive effect in this regard, as was determined

earlier through the analysis of statistics, may be the further improvement of the legislative framework regarding the activities of the National Police of Ukraine. Besides, it is necessary to organize and stimulate the use of a wider range of information and analytical tools by law enforcement agencies.

3.3. Analytical tools used in crime analysis to investigate crimes

Crime analysts use a wide range of analytical tools in their practice, which involve the use of certain technical means, special methods or software products in order to process information about the commission of crimes. In the most general form, the classification of instrumental means of criminal analysis includes the following elements: methodologies and techniques of crime analysis (network analysis, ANACAPA, SOCTA); software tools for general use (Microsoft Excel, MatCAD, MatLAB, StatGraph, Statistica); traditional information search systems (Liga Zakon, Google, Information Portal of the National Police of Ukraine); specialized information and analytical systems (IBM i2 Analyst's Notebook, Palantir Gotham, HOLMS2, RICAS, Maltego, Crime Center (Shotspotter), Command Central Aware Motorola, SmartCOP, ePOOLICE) (Burdin, 2019; Strukov *et al.*, 2021).

The most common analytical tools are the following:

- Analytical assessment of the crime scheme — the analysis of the steps taken by criminals during the commission of a crime. Such analysis includes data on dates and times of incidents, associated persons and organizations, their movements, etc.;
- drawing up an association matrix — helps to compare and determine the relationships between several factors, as well as to exclude factors that do not have relationships with others;
- tracking of goods traffic – reflects the process of organizing the movement of certain prohibited items, for example, drugs;
- monitoring of communications — analysis of information that can be obtained by tapping telephone conversations, correspondence of criminals in various messengers, via e-mail, etc.;
- analytical assessment of the crime structure — may include cartographic analysis, analysis of series of incidents and other directions;
- analysis of criminal profiles — such profiles may contain mechanisms of committing crimes, skills, tools used by criminals, etc.;
- demographic analysis — the assessment of social changes affecting the crime rate, for example, the analysis of unemployment trends;
- event stream analysis —visualization of a number of certain events and the relationships between them is used during this analysis;

- the use of financial analysis in forensics — involves the use of a wide range of financial analysis tools in order to detect suspicious actions and offences;
- hypothesis testing — in the context of research, consists in using graphic means to determine whether all elements of the crime have been taken into account in the hypothesis advanced by the analyst;
- analysis of ties between criminals and suspected persons — consists in a visual representation of the relationships between the specified persons; other analytical tools (analysis of market profiles, networks, results, risks, assessment of operational capabilities, etc.) (Strukov *et al.,* 2021).

The above-mentioned tools are part of the functional of specialized tool platforms for crime analysis. The listed tools can be used on the platforms in whole or in part (the possibilities of using the tools vary depending on the platform used). The next section provides an overview of the most popular tool platforms that can be used in EU countries and, with certain adaptations, in Ukraine as well.

3.4. Tool systems of EU countries in the field of crime analytics. The practice of introducing the latest means of criminal analysis in Ukraine and the adaptation of European systems to Ukrainian realities

In many developed countries, in particular, the EU and the USA, the means of criminal analysis are widely used by law enforcement agencies, being mandatory for crime prevention activities. Special tool platforms adapted to the recording systems of a specific country are being developed to solve the tasks of law enforcement agencies in these countries. There are also a number of platforms that take into account international standards, in particular within the previously mentioned ILP model. They belong to the specialized information and analytical systems outlined in the above classification. The special capabilities of the main ones are discussed below.

IBM i2 Analyst's Notebook – this tool enables to transform complex sets of both structured and unstructured information into high-quality operational information by means of visual analysis. The advantages of the tool are a clear and convenient interface, the possibility of analysing social networks, as well as presenting the results of the analysis in the form of visualizations. The IBM i2 Analyst's Notebook exists for more than two decades, and during that time the technology has spread around the world: it is currently used by more than two thousand organizations to combat crime and terrorism (IBM, 2022).

Maltego is an open-source graphical link analysis tool that collects and visualizes information for investigative purposes. Maltego enables performing three main functions:

1. collect information — information can be collected from declustered sources and viewed in the form of a graph, which can contain up to 1 million objects. It is possible to access about 60 sources of information in Maltego Transform Hub. It is also possible to use one's own, commercial or public sources and perform transformations;
2. combine information — the ability to automatically combine information on the graph and determine the types of objects;
3. visualize connections — access to different layouts, application of object weights, possibility to add annotations and export graphics (Maltego, 2022).

Palantir Gotham – the system enables searching for the necessary objects through a single portal, without referring to different systems, because information has been collected by Gotham for more than ten years from complex data. This information is intended for use by defence agencies, intelligence agencies, organizations that help with natural disasters, and other users. Data are aggregated in almost real-time, helping to accelerate decision-making when urgency matters (Palantir, 2022).

ePOOLICE – a project financed by EU and European countries. As a result of its implementation, a prototype system for early detection and prevention of threats from organized criminal groups was proposed. The key features of the developed prototype are:

- information management in an uncertain environment;
- the ability to work with the central data storage;
- simultaneous processing of different file types;
- simplifying complex information by creating clear tables and data visualizations (UNICRI, 2022; Strukov *et al.*, 2021).

In the context of the introduction and use of these analytical systems in Ukrainian practice, it should be noted that all of them require adaptation to local realities, in particular, the specifics of the legislative framework. RICAS - Realtime Intelligence Crime Analytics System — can serve as an example of a purely Ukrainian project to create an intelligent crime analysis system. This system combines leading methods of crime analysis in real time, thus improving the effectiveness of crime detection — both close in the tracks and those that have been committed before (Ricas, 2022). The system enables performing the types of analysis shown in Figure 3.

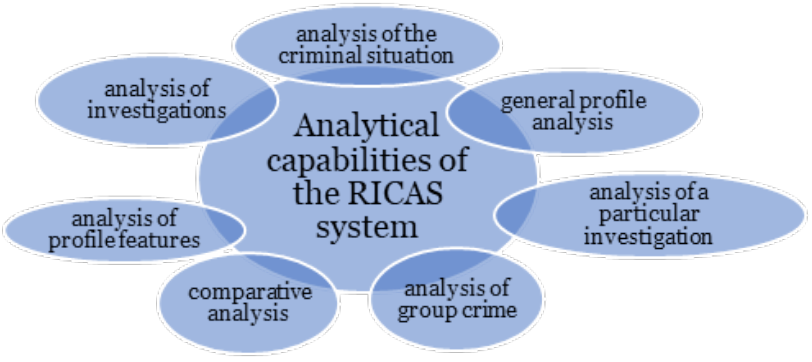

Figure 3. Analytical capabilities of the RICAS intelligent criminal analysis system (Ricas, 2022).

Such steps undertaken by Ukraine as the introduction of its own platforms for conducting criminal analysis testify to the readiness and ability of the country to change the traditional way of conducting cases to a new, more effective one. These actions bring Ukraine closer to compliance with the high requirements that exist in the EU countries for the system of law enforcement agencies, and contribute to the integration process. However, improving the effectiveness of the law enforcement agencies — through the use of the latest crime analytics tools among other things — contributes to improving safety and well-being of Ukrainian citizens.

4. Discussion

The conducted research proves the effectiveness of introducing current means of crime analytics when predicting, preventing and detecting crimes. This necessitates the use of such tools in Ukrainian practice, in particular, through research and adaptation of European experience to Ukrainian realities.

The research results are supported by the findings of researchers who studied aspects of crime analytics. Knyazev (2018) notes that the constant complication of the schemes and structure of criminal organizations requires effective actions from law enforcement agencies in response to this development. An experienced crime analysis using the crime analytics tools is of great importance for the success of such actions, which contribute to the understanding of criminal algorithms.

Tishchenko (2019) outlined similar views in the work, stating that crime analysis using the ILP model in the context of rapid transformation of crime should significantly increase the crime detection rates. Vidović (2022) notes that the spread of transnational crime and terrorism determine the urgent need for the introduction of ILP. As in this article, the researcher confirms the effectiveness of the implementation of the ILP model with crime reduction statistics, but in a different region (Serbia).

In their work, Korniienko *et al.* (2021) compare different policing models. In addition to the ILP, the researchers describe the features of the CompStat model (which is focused on crime, while the ILP is focused on identifying threats), a socially oriented model (aimed at building trust and strengthening communication between the police and the public).

However, this article focuses mostly on the ILP model, because, in the author's opinion, this model is the most widespread and effective, which is confirmed by the study of Sullivan *et al.* (2020), who define the ILP and POP (Problem-Oriented Policing) models as the two most popular policing models. The researcher notes that the latter was developed at the end of the 70's and aimed to move from purely reactionary policing to pattern analysis and recognition, community involvement and goal setting. ILP is based directly on POP.

Strukov *et al.* (2021) broadly outline current analytical tools and platforms for crime analysis. The researchers, revealed the features of such platforms in detail, and determined the analytical tools included in their functional. However, unlike this study, the work does not draw a parallel between the introduction of certain improvements in the field of crime analytics and their impact on the crime rate trends.

A number of studies also focused on the specifics of particular platforms for crime analysis. The features of the Maltego system studied in this article are quite vividly covered in the work of Mediná *et al.* (2018). In addition to general characteristics of the platform, the researchers indicted the types of data that can be entered into the system, namely: domain, username, URL, e-mail, image, DNS, IP, location, phrase, etc. Entering one of these types of data is followed by a transformation, which results in obtaining information related to the entered request, even in the form of another data type. By entering an e-mail, you can get an account in a certain social network. Their study focuses primarily on improving cyber security, while this paper covers a wider range of crimes.

Simmler *et al.* (2022) distinguished the IBM i2 Analyst's Notebook system as an advanced technology used by some Swiss police departments. It is noted that in practice this system is primarily used for the analysis of numerous digital evidence. The study of these researchers shows that the use of advanced technologies, in particular tool platforms, is an option,

not a strict requirement, even in some developed countries. However, considering that Switzerland ranks 130th out of 135 countries represented in the Crime Index ranking (Numbeo, 2021), that is, it is one of the safest countries in the world, the issue of improving the fight against crime in this country is probably not so acute as in Ukraine. Based on the results of this article, it is appropriate to recommend Ukraine to stimulate the use of analytical platforms in the activities of law enforcement agencies.

Federico and Thompson (2019) detail the capabilities of the Palantir Gotham platform and note the following features not mentioned in this article: lead generation, fraud detection, tax fraud detection, money laundering and asset forfeiture investigations. This and other mentioned works considered the platforms used for the purposes of crime analysis mostly as tools that facilitate and optimize the work of law enforcement agencies.

However, not all researchers have similar views. For example, Castets-Renard (2021) expresses an opinion that is opposite to the findings presented in this article. The researcher notes that the perception of intellectual police as a means to eradicate crime may be wrong. This is explained by a number of problems related to inefficiency, risk of discrimination and lack of transparency of actions.

Therefore, the conclusions drawn I this research have both supporters and opponents among researchers. This is why further research should focus on determining the risks and disadvantages of using the studied platforms that offer crime analysis tools, and comparing them with the identified advantages.

Conclusions

The transformation of criminal organizations, the emergence of new crime schemes and the growth of crime rates in general, in particular transnational crime and terrorism, determine the need to search for new combating methods. The study considered the use of the latest crime analysis tools to combat crime, which, among other things, contributes not only to the effectiveness of responding to committed crimes, but also creates opportunities for their prevention.

The article outlined the powers of the police in the field of information and analytical support and legislative aspects regarding the use of technical devices, technical means and specialized software. The statistics of crimes committed in Ukraine for 2013 to 2020 are provided by separate criminal articles. The most often violated articles of the Criminal Code were identified. It was also determined that the number of crimes under

these articles decreased after the adoption of the Law of Ukraine "On the National Police". In turn, one of the priorities of the new police is the use of the latest crime analysis tools, so trend changes can indirectly indicate the effectiveness of the use of the latest crime analysis tools by law enforcement agencies.

Besides, the article reviews the analytical tools used in crime analysis to investigate crimes, as well as the crime analysis tool systems of the EU countries. The following tool platforms used in EU countries were considered: IBM i2 Analyst's Notebook, Maltego, Palantir Gotham and ePOOLICE. The practice of introducing the latest means of crime analysis in Ukraine is outlined, in particular the features of the RICAS system, as well as the possibility of adapting European systems in Ukraine.

Further research should focus on determining the risks and disadvantages of using particular platforms that offer crime analysis tools, and comparing them with the identified advantages.

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