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Directions for the Implementation of Innovative Analytical and Statistical Technologies as a Tool for Corruption Counteraction

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ANNOTATION

The article sets out to explore the potential of innovative analytical and statistical technologies in monitoring, detecting, and counteracting corruption within state systems. The central objective is to clarify key concepts, determine the nature and content of these technologies, and analyse their applications in anti-corruption efforts. The research methodology combines the scrutiny of official documents, legislations, public authority websites, and software providers with a focus on their anti-corruption capabilities. The study reveals that analytical and statistical technologies constitute a specific form of information technology, embodied in functional information systems that fulfil organisational objectives and assist in decision-making processes. They assist primarily in the identification and prediction of probable cases of corruption or fraudulent activities, utilising mathematical methods and advanced analytical algorithms. Key areas where these technologies can significantly contribute include data collection and processing, communication and office processes, general management processes, decision-making processes, and expert systems development.

Key words: corruption counteraction, artificial intelligence, machine learning, information technology, information system, forensic

INTRODUCTION

Corruption remains one of the largest socio-economic issues affecting a country's development and undermining citizens' trust in governing structures. Innovative analytical and statistical technologies such as artificial intelligence, machine learning, big data analysis, and others, hold the potential to provide effective monitoring and detection of corrupt schemes. They provide the automation of large volumes of data analysis, which helps to identify discrepancies, inconsistencies, and anomalies that may indicate corrupt activities (Odilla, 2023). The relevance of this research topic is driven by the need to improve the effectiveness of anti-corruption measures and ensure transparency and accountability of governing structures, which is especially significant for a country at war. Implementing such technologies gives hope for reducing opportunities for corruption, providing effective monitoring of corruption risks, and faster recovery in post-war Ukraine.

The purpose of this article is to determine the directions for implementing innovative analytical and statistical technologies as a tool for monitoring, detecting and counteracting corruption in the state. To achieve this goal, the following tasks are defined: 1) to clarify the meaning of the main concepts; 2) to determine the essence and content of innovative analytical and statistical technologies; 3) to analyse the directions of application of innovative analytical and statistical technologies as a tool for monitoring and combating corruption in the state.

Research methodology. The study is based on observation and analysis of official documentation, current legislation, official websites of public authorities and producers of software, especially those that

focus attention on the possibilities of using their products as a anti-corruption tool. The study includes an analysis of modern information technologies, the sphere of anti-corruption policy, analysis of examples of innovative analytical and statistical technologies usage as a tool for corruption monitoring and counteraction. The empirical basis for the analysis consisted of materials from the media, examples of successful application of various information technologies for automating anti-corruption activity, materials from international non-governmental organisations, and so on.

RESEARCH RESULTS

1. DEFINITION OF THE MAIN CONCEPTS OF THE RESEARCH

Corruption counteraction. By corruption, we understand "the misuse of public office for private gain" (Rose-Ackerman & Palifka, 2016), which can have both a material and non-material form. At the same time, misuse is a violation of both formal regulatory and legal institutions, including norms of official behaviour and ethics, as well as informalised norms of behaviour, ethics, and morality.

Prevention, counteraction, and combating are three distinct directions of anti-corruption activities. If prevention and combating corruption's manifestations in the state imply joint activity of all interested parties (state, business, civil society) regarding the "detection, research, limitation or elimination of phenomena that generate corruption offenses or contribute to its spread... by all available means of communicative interaction, the implementation of which is objectified by preventive, repressive and liquidation measures", then counteraction is purely the activity of "anti-corruption and law enforcement agencies, aimed at detecting corruption offences, proper investigation, bringing offenders to justice, and also protecting persons who have been harmed as a result of corrupt actions" (Prykhodko, 2020, pp. 140-141).

We believe it is necessary to take as an axiom the statement that corruption as a phenomenon cannot be eliminated. However, the only thing that can be done with it is to counteract its spreading. Therefore, under the concept of "corruption counteraction" we consider the activity of anti-corruption actors in preventing corruption manifestations (detection and attempts to eliminate the causes of the spread of corruption crime); fighting corruption acts (their termination, disclosure, and direct investigation) and minimising and liquidating the consequences of committed corruption offences (Okuniev, Boiko, & Lukin, 2018).

Innovative analytical and statistical technology. In a general sense, the term "analytical-statistical technology" should be understood as a documented procedure or data analysis algorithm. According to (Köbis, Starke, & Rahwan, 2022; Kovtun, 2011; Odilla, 2023), analytical and statistical technologies are divided into traditional (classic) and automated ones.

The first category involves the activity of 1-2 experts with minor use of computer (information) technologies, during which the analysis of interrelations, interdependencies of various indicators take place in order to identify deviations from the norm (this can include the method of stereotypes, adjusted indicators, associated comparisons, and so on).

In turn, automated technologies imply the involvement of intelligent systems in data processing, which are trained to perform analytical and statistical operations with datasets and are capable of replacing a human in most performed operations. Such technologies include data mining, anomaly (novelty) detection, or new knowledge discovery. The use of these algorithms allows for the automation of several specialists' work and simplifies the process of preparing reports about exceptional (new, anomalous) situations. Based on this classification, automated technology groups should be considered as innovative analytical and statistical technologies. We should add that the use of these technologies in the current conditions of society's development is impossible without using technologies such as artificial intelligence, machine learning, deep learning, neural networks, natural language processing (NLP), network analysis, real-time data analysis, big data processing which allow for obtaining fast and accurate results of large data volume analysis.

So, by the innovative analytical and statistical technologies we define:

– in a broad sense – as a set of methods and tools based on the use of mathematical and statistical methods of data analysis in order to identify useful dependencies and regularities in data, increase the efficiency of decision-making and identify anomalies in various spheres of activity;

– in a narrow sense – as a process of using the most advanced methods and technologies of data analysis, such as machine learning, deep learning, neural networks, natural language processing, graph analysis, etc. in order to identify complex dependencies and useful patterns in data. Such technologies also include methods of data analysis in real time, which allow obtaining quick and accurate results of analysis of large volumes of data.

2. INNOVATIVE ANALYTICAL AND STATISTICAL TECHNOLOGY: ESSENCE AND CONTENT

To understand their essence, and then their place and role, we will have to deal with the essence of a more general phenomenon called "information technology". At the current stage of development, information technology is defined 1) in the narrow sense, as a way of producing information products and services of the necessary quality and quantity with optimal costs, considering current conditions and time expenditures; 2) in a broad sense, as a set of rational methods and means of information activity that ensure the planned result (Tracy, 2021).

Modern information technologies share general characteristics with industrial ones. At the same time, they have their specifics, which manifest in the predominance of intellectual work, a variety of product and service assortments, and small volumes of goods and services of one denomination compared to the traditional industry. Any modern analytical and statistical technology has all the attributes of practical technology. The goal of analytical and statistical technology is the efficient production of information products and the rational use of information resources in the process of satisfying the user's information needs. The objects of analytical-statistical technology are information (mainly documentary) and consumer inquiries (Swedin & Ferro, 2022).

Any analytical-statistical technology in its practical application (at the level of an organisation, region, industry, state, world) exists in the form of (or generates) an information system (Haigh & Ceruzzi, 2021). An information system is an organisationally ordered set of documents (arrays of documents) and information technologies, including the use of computer and communication funds, that implement information processes (Vanneschi & Silva, 2023). Information systems have an extremely wide range of applications in the fields of science, economics, culture, politics, art, and private life.

The variety of information technologies and areas of their practical application generate the need for the development of theoretical and empirical classifications. Within the framework of our study, we will consider only those classification options under which analytical and statistical technologies fall in one way or another (Thakare, Laddha, & Pawar, 2023).

According to the criterion of the application sphere, basic, applied, and special information technologies are distinguished. According to this typology analytical and statistical technologies as a complete (functioning) information system belong to special information technologies.

By purpose, information technologies are divided into support (provision) and functional information technologies. In this typology, analytical and statistical technologies are directly related to functional information technologies, since information systems created by this type of technology always imply achieving a goal defined by the management of an organisation, enterprise, local, regional, national, etc. authority.

According to the degree of coverage of management tasks, data processing information technologies, office automation, management, decision-making processes, and expert systems are distinguished. In this classification analytical and statistical technologies can be attributed to three types minimum: management, decision-making, and expert systems, since each of these types is directly related to the decision-making process, which can occur automatically (management), semi-automatically (decision-making), and manually (expert system). At the same time, the operation of the mentioned technologies is impossible without the application of data processing technologies and office technologies, as they

are responsible for forming databases, without which the operation of analytical or statistical algorithms is impossible.

As already mentioned, information technologies, including analytical and statistical technologies, get their practical embodiment in the form of an information system, which combines both technical means (computers, communication devices and channels, peripheral devices, data input/output devices, etc.) and software applications that ensure the functioning of the technical part and the analytical component, including statistics.

The involvement of analytical and statistical technologies as a tool to counteract corruption at the state level is conditioned by the specifics of the corruption identification process. The application of relevant technologies is possible under the condition of perceiving corruption as a type of fraud. Therefore, we consider it appropriate to use the approach of N. Kovtun (Kovtun, 2011), according to which the search for corruption in modern conditions of social development must be carried out based on the comprehensive use of mathematical, analytical, and psychophysical research methods, which will make it possible not only to identify but also to predict probable cases.

Mathematical methods of identifying corruption primarily include the application of the so-called Benford's law in Nigrini and Mittermaier's tests in 1997, which were used by Ernst & Young during audit inspections. The essence of the test is that "if, as a result of the research and construction of a sequence of digits of empirical data, significant discrepancies with the reference values are found, this is a signal for conducting a special study, which will reveal the cause of such discrepancies" (Kovtun, 2011). Such tests can be applied during internal investigations, audits, tax inspections, evaluations, etc., and allow obtaining additional confirmations about the presence/absence of a corruption/fraudulent component, intentional/unintentional errors in the activities of employees, counterparts, organisations, enterprises, etc. The only condition for the effective application of mathematical methods is the necessity of large data arrays, so they are not suitable for organisations with non-intensive operational activity. Therefore, analytical and statistical methods are more advanced in terms of possibilities for identifying corruption/fraudulent activity. This group of methods is conditionally divided into traditional and automated groups.

Traditional methods include methods such as the method of related comparisons, the method of special calculation indicators, the method of stereotypes, and the method of corrected indicators. These methods are considered traditional because calculations can be made "on one's fingers", on a calculator, at least in a spreadsheet application (Microsoft Excel, Google Tables, etc.).

Their opposite are methods whose implementation is impossible even under conditions of using pivot tables – automated analytical and statistical methods. The first feature of these methods is the permissible size of the data array. For example, when using a traditional method with the use of standard Microsoft Excel (without using the PowerQuery function), the user is automatically limited in the number of possible entries in one table to 1,048,576 rows («Excel Specifications and Limits,»), while automated analytical methods are designed to process a much larger number of values, for which database technologies and corresponding environments/data processing languages (S, R, Python, SQL) are used, implemented both on terms of a free license (R, Python) and conditionally free (SPSS, SAS, SAP, Power BI). The use of additional technologies allows for automating the process of collecting primary information (for example, the process of entering data of socio-economic and political studies is automated using image recognition technologies), cleaning (processing) data arrays (application of conditional expression logic or machine learning technology). Another advantage of this group of methods is the possibility of using anomaly detection algorithms (outliers, novelty). It is these algorithms that have become widespread (implemented) in intrusion detection systems, fraud/corruption identification, health monitoring, electoral anomaly detection, insider detection on stock exchange, seismology, etc. Among the most common anomaly detection algorithms are: statistical testing, model test, iterative algorithm, metric algorithm, ensemble of algorithms (Han, Hu, Huang, Jiang, & Zhao, 2022).

In addition, innovative analytical-statistical methods as an element of anti-corruption activity are actively implemented even in the field of behavioural sciences, a general characteristic of which was illustrated in such series as "House MD" («House MD,» 2004-2012) or "The Mentalist" («The

Mentalist,» 2008-2015). However, they gained the most popularity thanks to the series "Lie to Me" («Lie to Me,» 2011-2013), according to which theoretical work in psychology was organically combined with advanced information technologies (image recognition technologies), which allows the main character (Dr. Lightman) to investigate intricate and complex criminal and/or administrative cases. Although most scenarios are fiction or assumptions, they are all based on the real capabilities of modern computers used to automate the process of combating speeding, searching for potential terrorists at airports, and more.

3. DIRECTIONS OF INNOVATIVE ANALYTICAL AND STATISTICAL TECHNOLOGY APPLICATION

The main areas of management optimisation in organisations, enterprises, institutions, production sectors, and the state as a whole are increasing its productivity and reducing the labour intensity of management by eliminating losses of working time and combining functions, developing functional division of labour, mechanising and automating managerial work, improving the production and organisational structure, reducing documentation and rationalising document flow. The main direction of increasing the efficiency of production management is the automation of information work (*Responsible Artificial Intelligence: Challenges for Sustainable Management*, 2023). To automate the processes of collecting, processing, transmitting, and storing information, and its output when needed for solving production tasks, so-called automated production management systems (APMS) are created. The development and application of APMS is one of the most important ways to improve management and leadership of social production.

The sphere of counteracting corruption, which has reached the size of a whole industry of information production, including elements of intelligence, normative, organisational, and technological activities, has not been left out. The counteraction to abuse and violations in the workplace directly relates to the purely managerial task, the content of which is not only the formulation of norms, procedures for the activity of officials, but primarily the processes of investigating any uncertain or anomalous situations that have signs of intentional distortion of reporting (control) documentation (Odilla & Veloso, 2021). During investigations, experts try to find as much evidence as possible, both for the proper and unquestionable classification of the event (as an accidental situation, as abuse at work, as a deliberate violation (fraud) or as a deliberate violation with conspiracy or collusion (corruption)), and to identify the circle of suspects or guilty parties (Lawless, 2022). At the current stage of information technology development, their use during the implementation of fraudulent/corruption schemes, anti-corruption specialists also have to arm themselves with appropriate equipment – to automate their investigative activities.

When it comes to research related to countering corruption with information technology, most of it focuses on areas such as (Adam & Fazekas, 2018):

– digital government services and e-government;
– crowdsourcing platforms;
– information tools;
– transparency portals and big data;
– distributed ledger technologies (DLT) and blockchain;
– artificial intelligence.

In our opinion, the process of implementing innovative analytical and statistical technologies should be considered from the point of view of end products (information systems, information environments), the use of which in one way or another can contribute to the goal of countering corruption in the state. Therefore, today we can highlight at least five directions of automation of management activities in general, and anti-corruption activities in particular:

– automation of data collection and processing;
– automation of communication and office processes;
– automation of management processes;
– automation of decision-making processes;
– development of expert systems.

Analytical and statistical technologies find their implementation most in 4 of the defined directions: data collection/processing; management; decision and expert support. However, we will consider all the specified directions in the order of hierarchy and scale (level) of implementation.

1. Data collection and processing. Information technology for data processing is developed to solve well-structured problems, according to which the necessary input data, algorithms and other standard processing procedures are known. This technology is used at the level of operational (executed) activities with low qualifications to automate some routine, constantly repeated operations of managerial work (VanderPlas, 2023). Examples of the application of relevant technologies include both individual (text and table editors, local database management systems from packages such as Apache OpenOffice, Apple iWork, Corel WordPerfect Office, LibreOffice, Microsoft Office, WPS Office, including applications for working with pdf from Adobe, ABBYY, Foxit, Sumatra, etc.) and corporate information systems (1C, BAS, Microsoft Dynamics, Oracle E-Business Suite, SAP, etc.), including cloud applications like Google or Zoho.

2. Communication and office. The automation of communication and office processes is not intended to replace the existing traditional communication system of staff (with meetings, phone calls, and orders), but only to complement it with an automated office – the organisation and support of communication processes both inside the organisation and with the external environment based on computer networks and other modern means of transmitting and working with information (*Fraud in Communications*, 2016).

As for this segment of technologies, here we have a very branched list of applications that includes applications from the previous point: Apache OpenOffice, Apple iWork, Corel, Google Suite, LibreOffice, Microsoft Office, Oracle, SQL, Visual FoxPro, Jamovi, KNIME, Maple, MATLAB, MaxQDA, PSPP, R, RapidMiner (Altair), SAS, SPSS (IBM), Statistica, Adobe Acrobat, ABBYY FineReader, Kofax OmniPage, Zoom, Amazon Drive, Apple iDrive, Dropbox, Google Drive, Microsoft OneDrive, and so on.

The main advantage of office automation for anti-corruption specialists is that communication is one of the forms of receiving information about committed corruption crimes, primarily this concerns questioning the circle of suspected persons. Remote communication systems automate the processes of recording conversations with witnesses, victims, and participants and accomplices of offences. It should be noted that some functions of communication information technologies can be integrated into most corporate information systems: 1C, BAS, Microsoft Dynamics, Oracle E-Business Suite, SAP.

3. General management processes. Information technology for general management processes is implemented with the aim of meeting the information needs of all employees of an organisation, enterprise, or institution, who are tasked with decision-making. This technology is oriented towards working with less structured tasks and can be useful at any management level (*Information Technology for Management: On-Demand Strategies for Performance, Growth and Sustainability*, 2018).

Starting from this level of implementation of information technologies, we talk about their groups, namely: Enterprise Resource Planning systems (ERP), Customer Relationship Management systems (CRM), Supply Chain Management systems (SCM), Material Requirements Planning systems (MRP), Human Resources Management systems (HRM), Business Intelligence support systems (BI).

A characteristic of such systems is the uniqueness of the system configuration for each organisation, even if there are typical templates. Therefore, a significant amount of costs for these applications consists not of license payments, but payments for setup (implementation) and maintenance of the relevance and compliance of the algorithms of analytical calculations with the requirements of the legislation (calculation of VAT, single tax, social contribution, and other mandatory payments that may affect the cost of the organisation's goods and services). That's why at this level we talk not about specific applications, but about software systems (1C, ADempiere, Aptean, Bitrix24, IBM, Microsoft Dynamics, Odoo, Oracle E-Business Suite, SAS) or frameworks developed, for example, by Oracle or Microsoft.

4. Decision-making processes. The main feature of decision support technology is a qualitatively new method of organising human-computer interaction. The decision-making, which is the ultimate goal

of this technology, occurs as a result of an iteration process in which two parties participate: 1) the decision support system as a computing unit and management object; 2) the human as a governing element, setting the input data and evaluating the computer's calculation results. Iterations continue until they are stopped by the user (analyst/manager). This technology allows the information system, together with the user, to create new information for decision-making (Bandyopadhyay, 2023).

Decision support technologies can be used at any management level with the function of coordinating decisions at different management levels. In this case, these technologies may include the functional capabilities of previous technologies (data processing and analysis, visualisation). The main difference of a such system is not only a well-developed (hierarchical) database and base (mathematical) models but a subsystem for managing databases (DBMS) with a system for managing the interface between the user (analyst, manager) and the computer.

Decision support systems are, in most cases, in demand from corporate customers with a significant number of personnel and financial flows, for whom the costs of such applications are not a luxury, but a mandatory element of the organisation's image.

As with general management technologies, at the level of decision support systems, it is better to talk about companies that provide services for the development and implementation of relevant information solutions in economic activities, rather than the names of specific applications. Thus, the most popular manufacturers of corporate solutions are: Apache Software Foundation, Clickhouse Inc, IBM, icCube, Jedox, Kyvos Insights, Microsoft, Oracle, Pentaho, SAP, SAS Institute.

Among standalone information systems (software that can be installed on a workstation), which allow to carry out analytical and statistical analysis of data, we can highlight the following: IcCube, GNU PSPP, Microsoft PowerBI, SageMath, Scilab, STATA, Tableau, and numerous applications of IBM (Watson, Cognos Analytics, Planning Analytics, SPSS) and SAS (Anti-Money Laundering, Detection and Investigation, Viya Portfolio, Visual Analytics).

Let's mention the products of the last two giants of the analytical and statistical software industry. If most manufacturers of similar products emphasise the capabilities of their applications to perform complex mathematical calculations, IBM and SAS actively offer their products capable of automating any analytical and statistical activity. Moreover, they offer solutions to counter fraud, corruption, money laundering, and other abuses/violations in the workplace.

One of the main disadvantages of these applications is their proprietary nature, that is, they belong to paid software (the cost of the software can only be calculated in direct communication with the sales department, which must first formulate a so-called technical task that determines the final cost of the software). An alternative to these solutions is FOSS (free and open-source software), or more specifically, in the context of analytical and statistical technologies, languages and programming environments for statistical calculations, analysis and data visualisation such as R and Python. The free nature of these solutions is offset by the need for analysts to have the relevant competencies in data analysis using these languages, understanding the principles of their work, and understanding their advantages and disadvantages. The capabilities of the applications are greatly expanded by additional packages (libraries), among which there are packages that can provide any analytical and statistical analysis, including anomaly detection algorithms.

It should be noted that a separate direction in the development of information systems is data warehousing navigation tools, the need for the development of which is associated with the need to develop effective search technologies that would effectively process large volumes not only of "raw" data but also analytics formed on their basis – data showcases, graphic information, dashboards, etc. Among the most popular commercial corporate search systems, we can highlight: Algolia («The flexible AI-powered Search & Discovery platform,»); IBM Watson Discovery («IBM Watson Discovery,»); Yext («Power Your Website with the World's Best Search,»); Swiftype («A Powerful Search Experience for Your Website - Without the Learning Curve,»); SearchUnify («SearchUnify for Sales & Customer Service,»), ElasticSearch («Elastic: Search More, Spend Less,»); Solr («Solr is the popular, blazing-fast,

open source enterprise search platform built on Apache Lucene,»); Sphinx («Introduction to Search with SPHINX,») and so on.

5. Expert systems development. The most significant progress among computer information systems is noted in the field of developing expert systems based on the use of artificial intelligence. The greatest success in the application of expert systems as an analytical and statistical technology in economic activity has been recorded in the activity of the so-called "Big Four". The "Big Four" is the largest global network of auditing and consulting firms: Deloitte, PricewaterhouseCoopers, Ernst & Young, and KPMG.

Expert systems provide the ability for a manager or analyst to receive expert consultations on any problems for which these systems have accumulated knowledge. The basis of expert systems is artificial intelligence technologies. Artificial intelligence is usually understood as the ability of computer systems to perform actions that could be called intelligent if performed by a human (Gupta & Nagpal, 2020).

Expert systems were first developed in the 1970s as an extension of artificial intelligence technologies (Smith, 1994). Systems are created with the aim of reducing potential user error in the decision-making process and simulating those analytical thinking processes used by experts in a particular field (Leonard-Barton & Sviokla, 1988). Implementation of expert systems in economic activity is possible in areas where professional judgment is needed. Typically, the use of expert systems as a tool to combat fraud or corruption is most appropriate in situations related to the purchase/sale of goods and services, when there is a significant risk of fraudulent/corrupt schemes being applied (Berru, Batista, Torres-Carrión, & Jimenez, 2020).

As one of the main applications of artificial intelligence, expert systems are computer programs that transform the experience of experts in any field of knowledge into a form of heuristic rules (heuristics). They do not guarantee an optimal result with the same probability as the regular algorithms used to solve problems within the decision support technology. However, they often provide sufficiently acceptable decisions within their practical use. All this allows the use of expert system technology as a consulting system.

We believe it is necessary to speak further about machine learning and artificial intelligence. These are two closely related but different concepts in the field of computer science. In a general sense, artificial intelligence is the field of science that seeks to create machines that can act with intellect similar to human. Machine learning is one of the technologies used to create such machines (*Artificial Intelligence Technology*, 2023).

In general, machine learning is a methodology that allows computers to learn from data without explicit programming. Instead of developing a program that solves a specific task, machine learning algorithms use sets of data to teach the computer, from which artificial intelligence independently creates its own logic of reasoning (formulating conclusions based on existing data, facts, precedents) (*Managing Machine Learning Projects in International Development: a Practical Guide*, 2022).

Artificial intelligence, on the other hand, is a broader concept that encompasses all technologies aimed at creating computer systems that can act intelligently, that is, perceive, process and use knowledge and solve tasks that require human intellect. Artificial intelligence technologies may use machine learning methods, but they can include other approaches, such as expert knowledge systems, knowledge-based problem solving and neural networks. Thus, machine learning is one of the methods used in the field of artificial intelligence (Köbis, Starke, & Rahwan, 2022). Both of these concepts are used in various fields, including corruption search, where machine learning can be used to analyse large volumes of data, and artificial intelligence can be used to develop systems that can make decisions based on this analysis.

As noted by Köbis, Starke, & Rahwan (2021), Odilla (2023), technologies based on algorithms, methods of artificial intelligence and/or machine learning have created a new category of applications, different from traditional or classic methods of implementing analytical and statistical procedures. The main difference of the latest tools is considered to be their ability to function in autonomous mode, that is, without human participation.

Analysing the content of existing expert systems and decision support systems, one can conclude about their similarity, since both systems provide a high level of decision support. However, there are three essential differences. First, problem-solving within decision support systems reflects the level of user's (analyst/manager) understanding and their ability to get and understand decisions (Bandyopadhyay, 2023). Expert system technology, on the other hand, offers solutions that may exceed the intellectual abilities of the user (Gupta & Nagpal, 2020). Secondly, the difference between these technologies lies in the ability of expert systems to explain their reasoning during the decision-making process (*Explainable AI: Foundations, Methodologies and Applications*, 2023). Very often these explanations are more important to the user than the decision itself. Finally, the third difference is related to the use of a new component of information technology – knowledge. If an expert system recognises situations for which it was not intended (developed), it must notify the user about the unreliability of its own answers (Kangra & Singh, 2023).

CONCLUSION

In the end, we can generalise our findings to such points.

Innovative analytical and statistical technology is a type of information technology, which is embodied in the form of a functional information system aimed to fulfill organisational objectives and assist in decision-making processes.

These technologies are considered essential tools for countering corruption at the state level, primarily by identifying and predicting probable cases. The application of mathematical methods and advanced analytical and statistical algorithms can reveal inconsistencies and potential corruption or fraudulent activities.

Counteracting corruption has also benefitted from advancements in information technologies. Currently, efforts to counter corruption focus on digital government services, crowdsourcing platforms, transparency portals, big data, and artificial intelligence. In this context, there are five key areas where analytical and statistical technologies can contribute: data collection and processing, communication and office processes, general management processes, decision-making processes, and the development of expert systems.

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Directions for the Implementation of Innovative Analytical and Statistical Technologies as a Tool for Corruption Counteraction

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ABSTRACT

Relevance of the topic. The article sets out to explore the potential of innovative analytical and statistical technologies in monitoring, detecting, and counteracting corruption within state systems. The central objective is to clarify key concepts, determine the nature and content of these technologies, and analyse their applications in anti-corruption efforts. The research methodology combines the scrutiny of official documents, legislations, public authority websites, and software providers with a focus on their anti-corruption capabilities. The study reveals that analytical and statistical technologies constitute a specific form of information technology, embodied in functional information systems that fulfil organisational objectives and assist in decision-making processes. They assist primarily in the identification and prediction of probable cases of corruption or fraudulent activities, utilising mathematical methods and advanced analytical algorithms. Key areas where these technologies can significantly contribute include data collection and processing, communication and office processes, general management processes, decision-making processes, and expert systems development.

The problem. Corruption remains one of the largest socio-economic issues affecting a country's development and undermining citizens' trust in governing structures. Innovative analytical and statistical technologies such as artificial intelligence, machine learning, big data analysis, and others, hold the potential to provide effective monitoring and detection of corrupt schemes.

The purpose of this article is to determine the directions for implementing innovative analytical and statistical technologies as a tool for monitoring, detecting and counteracting corruption in the state.

Research object: Application of innovative analytical and statistical technologies in the fight against corruption.

The results. Innovative analytical and statistical technology is a type of information technology, which is embodied in the form of a functional information system aimed to fulfil organisational objectives and assist in decision-making processes. These technologies are considered essential tools for countering corruption at the state level, primarily by identifying and predicting probable cases. The application of mathematical methods and advanced analytical and statistical algorithms can reveal inconsistencies and potential corruption or fraudulent activities. Counteracting corruption has also benefitted from advancements in information technologies. Currently, efforts to counter corruption focus on digital government services, crowdsourcing platforms, transparency portals, big data, and artificial intelligence. In this context, there are five key areas where analytical and statistical technologies can contribute: data collection and processing, communication and office processes, general management processes, decision-making processes, and the development of expert systems.

Keywords: corruption counteraction, artificial intelligence, machine learning, information technology, information system, forensic.

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Inovatyvių analitinių ir statistinių technologijų, kaip kovos su korupcija priemonės, įgyvendinimo kryptys

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ANOTACIJA

Straipsnyje siekiama ištirti inovatyvių analitinių ir statistinių technologijų potencialą stebint, nustatant ir kovojant su korupcija valstybės sistemose. Tikslas – išsiaiškinti pagrindines sąvokas, nustatyti šių technologijų pobūdį ir turinį bei išanalizuoti jų taikymą kovojant su korupcija. Tyrimo metodika apima oficialių dokumentų, teisės aktų, valdžios institucijų svetainių ir programinės įrangos tiekėjų tikrinimą, daugiausia dėmesio skiriant jų kovos su korupcija galimybėms. Tyrimas atskleidžia, kad analitinės ir statistinės technologijos yra specifinė informacinių technologijų forma, įkūnyta funkcinėse informacinėse sistemose, kurios įgyvendina organizacinius tikslus ir padeda sprendimų priėmimo procesuose. Jie pirmiausia padeda nustatyti ir prognozuoti galimus korupcijos ar sukčiavimo atvejus, naudojant matematinius metodus ir pažangius analitinius algoritmus. Pagrindinės sritys, kuriose šios technologijos gali labai prisidėti, yra duomenų rinkimas ir apdorojimas, ryšių ir biuro, bendrieji valdymo, sprendimų priėmimo procesai ir ekspertų sistemų kūrimas.

Raktažodžiai: kova su korupcija, dirbtinis intelektas, informacinės technologijos, sistema.

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