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RISK MANAGEMENT AND REGULATION: IMPLEMENTATION OF ALGORITHMIC DECISION-MAKING SYSTEMS

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ABSTRACT

Objective: The widespread introduction and use of algorithmic decision-making systems reduces time and transaction costs and saves human resources. However, in addition to obvious advantages, the use of algorithms can carry risks, sometimes very serious ones.The purpose of this study is to categorize algorithmic decision-making systems by various parameters, identify the main risks associated with the use of these algorithms, and propose a set of measures to reduce the negative consequences of using such systems.

Methods: The research methods are based on a comprehensive analysis of a limited number of studies that were selected according to special parameters. The methods of analogy and comparative analysis were also used.

Results: The main features of the use of algorithmic decision-making systems are analyzed. Based on the results of the study, a classification into types according to criteria is proposed, and the risks of using algorithmic decision-making systems are classified.

Conclusion: A system of measures to minimize the negative consequences of using algorithms is proposed: a ban on the use of algorithm systems in the riskiest areas, a requirement to provide reports from government agencies using algorithms in their activities, mandatory notification of individuals if a legally significant decision has been made against them by the algorithm system, granting individuals the right to appeal a legally significant decision.

Keywords: Decision-making algorithm; Artificial intelligence; Legally significant decisions.

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INTRODUCTION

The rapid development of artificial intelligence has led to the development of algorithmic decision-making (ADM) systems that allow for processing large amounts of data and making decisions based on them (Akhmetshin et al. 2024; Littman 1996). It is important to note that an ADM system can make a decision that has legal consequences (Levy, Chasalow 2021, Sultonova et al. 2023). An example is the case when, in 2020, a lawsuit was filed in the Amsterdam district court by a private courier company against Uber, challenging the decisions of AI to dismiss an employee. This lawsuit provides reliable information about the dismissal of employees based on an automated decision made without human participation (Vasyukov 2023). Uber drivers were sent text messages stating that their credentials had been deactivated, and they were therefore suspended from work without providing evidence of guilt and without the opportunity to challenge the decision made by the algorithm (Arkhipov, Naumov 2021).

As practice shows, legally significant decisions made using ADM systems can be erroneous or incorrect (Vasyukov, Mitroshin 2023). This situation may arise for various reasons, either due to errors in the source data, or when the algorithms themselves are unbalanced, which leads to false conclusions based on which a decision is made (Bedford-Strohm 2022; Labutina et al. 2023). The logic of decision-making by ADM systems is not always explicable. Experts identify the risks of using ADM systems and consider the main reasons why systems can make erroneous legally significant decisions (Coston et al. 2023). These issues are relevant and have practical significance since the percentage of ADM system use is growing (Akhmetshin et al. 2024), and mistakes in making legally significant decisions can not only affect but also violate the legitimate rights and interests of large groups of people (Polovchenko 2021).

The main purpose of the study is to classify ADM systems according to different criteria, identify the main risks of using algorithms, and propose a system of measures to minimize the negative consequences of using ADM systems.

METHODS

To identify the risks of using ADM systems and create a classification of ADM systems, we selected the work of researchers from different countries whose research,

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in our opinion, has a long-term impact on research trends on this issue. In this study, a desk review of works and a comparative analysis of works were used. For a comprehensive analysis, we selected studies that contained the definitions of the terms "artificial intelligence", "decision-making algorithm", "algorithm for making legally significant decisions", and "risks of using decision-making algorithms".

When searching for documents, we followed the Preferred Reporting Elements for Systematic Reviews and Meta-analyses (PRISMA) standards.

Step 1: Data Collection

We selected works written by scientists on the following topics: AI, decision-making algorithms, algorithms for making legally significant decisions, and risks of using decision-making algorithms. A bibliographic search was conducted in Scopus, Web of Science, and Google Scholar and on official websites where the main international legal acts are posted. We collected 175 publications in several categories.

Step 2. Filtering data using selection criteria.

The studies were selected according to the following criteria:

1. The author had at least three publications on the subject of AI, decision-making algorithms, algorithms for making legally significant decisions, or risks of using decision-making algorithms over the past 10 years;

2. Numerical superiority of more than 50% of legal research in the total number of publications by the author;

3. The author's profile had to indicate that their publications were thematically related to the legal sciences;

4. The work should have been written between 1996 and 2024.

With this approach, more than 175 publications were initially selected.

Step 3. Filtering data by reading the full text.

We read the full text of the papers if the title and annotation made it difficult to determine the relevance of the topic. After a careful selection, 52 papers were selected.

Using this technique allowed us to identify the main risks of using ADM systems, classify ADM systems into types according to various criteria, and propose a system of measures to minimize the negative consequences of using algorithms for making legally significant decisions.

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RESULTS

Widely used ADM systems are software code that provides analysis of a large amount of data based on which a system of algorithms makes a decision (Newell, Marabelli 2015). ADM systems are successfully developing, in confirmation of this fact, the Gartner research group made a report in which it predicted that ADM systems would be used in a variety of fields and by 2030 would account for 44% of the market for the production of AI (Gillingham 2019).

Analyzing the application of AI, the researchers paid attention to the problems of making legally significant decisions by an automated algorithm system. Studying the ADM technologies, they identified the categories of ADM where the division into types was based on the criterion of human participation in decision-making:

- the ***"human within the perimeter"*** option assumes full control over decision-making, while the algorithm system only provides recommendations that cannot be implemented without active human action (Kochenderfer et al. 2022; Alibabaei et al. 2022; Gillingham 2019; Green, Chen 2019; Ramirez et al. 2009, Matvienko et al. 2022);

- the ***"human outside the perimeter"*** option, where a person does not control decision-making by a system of algorithms and cannot influence decision-making and even correct it (Harper 2005; Yang et al. 2020; Pathak et al. 2024; de Paula, Marins 2018; Cheng et al. 2019);

- the ***"human above the perimeter"*** option, when the human influence on decision-making by the algorithm system is limited, but a person can correct the decision during the algorithm operation (Žliobaitė 2017; Corbett-Davies et al. 2017; Burton et al. 2020; Smith 2020).

In addition to this classification, the ADM systems can be classified into the following types depending on the decisions made by the algorithm:

- ADM systems that make decisions not entailing legally significant consequences. This group includes algorithms that form optional recommendations and instructions;

- ADM systems that make legally significant decisions determining the rights and obligations of the parties. Such legally significant decisions include the conclusion of contracts, determining the amount of penalties, arrest, dismissal, etc.

ADM systems are conditionally divided into man-made and automatically program-generated (De Campos, Falcone 2017). Deterministic and non-deterministic

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ADM systems should also be distinguished (Bedford-Strohm 2022). Deterministic decision-making algorithms are algorithms where the result of program execution is always the same with the same input data (Karliuk 2018). There is no place for randomness in such algorithms, and they always give an accurate and definite result. Examples of deterministic algorithms are the insertion sorting method; quick sorting; and depth-first search (Peeters 2020). Nondeterministic algorithms, on the contrary, use randomness to make decisions. The result of such algorithms may be different at each launch since they use random numbers or events (Fagan, Levmore 2019). Examples of non-deterministic algorithms are random selection from a list and simulation (Gordon 2013).

deterministic and non-deterministic; adaptive and non-adaptive.

According to the areas of application, the ADM systems are divided into the following types:

- ADM used in business and management: they can be used to support decision-making in strategic planning, project management, business process optimization, customer data analysis, and marketing (Ashley, Branting 2001);

- ADM applied in the financial sector: ADM plays an important role in risk management, financial market analysis, determining the optimal investment portfolio, and assessing creditworthiness;

- ADM used in healthcare: it is used in the diagnosis and treatment of diseases, analysis of medical images, determination of optimal treatment methods and dosage of medications;

- ADM used in education: it can be used to analyze student data, optimize curricula, and evaluate the effectiveness of learning systems;

- ADM used in justice: this technology helps to analyze large amounts of data and provide recommendations on criminal and civil cases;

- ADM used in transport and logistics: it helps to optimize routes, manage vehicles, and determine the best ways to deliver goods;

- ADM used in public administration: it can help in analyzing social and economic data, identifying problems, and determining strategies for solving them (Kannai, Schild 2007).

Classification can help one understand the different types of decision-making systems, their strengths, weaknesses, and limitations. This allows the user to choose the most appropriate algorithm for a specific task. Classification helps to evaluate and

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compare different decision-making systems based on their effectiveness, accuracy, and other metrics.

The research mainly examines aspects of the functioning of the ADM in the "human outside the perimeter" variant, when the algorithm makes a decision with legal consequences, and the person does not control the situation and cannot influence the decision of the ADM.

Experts note that such ADM systems, in addition to advantages, carry certain risks (Kelly 2019) related to big data processing and some other factors. Analyzing the risks of using ADM systems, scientists most often mention the following:

- ***Data error:*** The quality of the data used to train algorithms can greatly affect the accuracy and efficiency of the system. Errors in data can lead to incorrect decisions and negative consequences (Ojha, Singh 2019; Kaliszewski 2000; Nebro et al. 2018; Mahmud et al. 2022);

- ***bias:*** algorithms can be trained on data containing biases or stereotypes, which can lead to discrimination or other negative consequences when using the system (Goodman, Flaxman 2017; Ali et al. 2017; Li et al. 2022; Hou, O'Brien 2006);

- ***violations of privacy:*** ADM systems collect and process a huge amount of data that may contain users' personal data, while there is always a risk of leakage of personal information (Chakrabarti et al. 2018; Greenstein 2022; Barfield 2018; Zuiderveen Borgesius 2020);

- ***vulnerability to attacks***: ADM systems can become a target for hackers or intruders who can manipulate data or attack algorithms to obtain an undesirable result (Yan, Zeleznikow 2022; Walters, Novak 2021; Leheza et al. 2022; Surden 2022).

The experts have analyzed the risks of using ADM systems in sufficient detail and presented a classification of the algorithms used, but it is also necessary to develop a system of measures to minimize the risks of using ADM systems in practice.

DISCUSSION

The widespread development and application of ADM systems is associated with several advantages: reduction of transaction (Ramirez, Knoester 2009; Zhdanova 2023) and time (Scholz Lauren 2016; Akhmetshin et al. 2023; Dokholyan et al. 2022) costs, removing the burden from many workers (Ananny 2018; Ydyrys et al. 2023).

Note that in practice, the large-scale use of ADM systems can lead to a massive violation of the rights and legitimate interests of individuals if the algorithm makes

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erroneous decisions (Muyang et al. 2023). For example, the database for predicting oncological diseases did not consider the fact that breast cancer was more relevant for black people who suffered from this disease twice as often, and thus, based on inaccurate data, the ADM system made an incorrect forecast (Kelly et al., 2019). We will add two significant risks to the ones we have already mentioned:

- Lack of flexibility: ADM can be limited by strict rules and parameters, which makes it less flexible compared to human thinking;

- Technology dependence: algorithmic systems depend on the quality and reliability of the technologies on which they are based. Problems with technology can lead to system failures or data loss.

To minimize risks when using ADM systems, it is necessary to bring transparency and explainability to the algorithm development process (Scherer 2019). Transparency will allow one to correct inaccurate data, based on which the algorithm makes a decision (Reiling 2020), and explainability will solve problems in algorithmic processes and thus improve the practice of using ADM (Perc, Ozer 2019). Mechanisms of transparency and explainability can be implemented at the level of "hard law" in the form of requirements, as well as in the form of recommendations within the framework of "soft law" (Contini 2020; Mirzagitova et al. 2023).

To ensure transparency in the functioning of ADM systems, it is necessary to consolidate classification criteria to categorize ADM systems by risk level. Depending on the level of risk, one can establish differentiated requirements for the algorithms used to ensure transparency, explicability, and accountability of such systems.

For ADM systems with a high degree of risk, a requirement should be established for mandatory control of all actions taking place in the system when making decisions.

For ADM systems with medium or low risk, the requirement for control of actions during decision-making should not be mandatory.

Depending on the risk level of the ADM system, a mandatory preliminary external assessment of the impact of the algorithm on the accuracy and relevance of the data on which the system was trained, the absence of discrimination and fairness in training materials should be carried out (Zuiderveen Borgesius 2018; Kiseleva et al. 2021).

It is advisable to ban the use of ADM systems in the riskiest areas in which it is difficult to establish a sufficient level of transparency and explainability (Moses 2017;

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Khoruzhy et al. 2023). For example, self-learning ADM systems making legally significant decisions that have a significant impact on the rights and obligations of a large number of people should not function without human control.

Government agencies using ADM systems should provide regular reports containing information about the data sets used, how they are generated, the frequency of updates, and other information (Liu, Lin 2019). The report may also contain information about complaints from interested parties about the decisions taken by the ADM system.

It is necessary to establish at the legislative level the requirement for mandatory notification of persons involved in a legally significant decision made by the ADM system that such a decision has been made based on algorithmic processing without human participation, and every person who does not agree with this decision should have the right to challenge it.

CONCLUSIONS

According to the results of the study, the features of ADM systems have been highlighted, and classification into types according to certain criteria has been proposed. The main risks when using ADM systems have been highlighted, among which we can name the following: data error; bias; violations of privacy; vulnerability to attacks; lack of flexibility; and dependence on technology. To minimize the negative consequences of using ADM systems, it is proposed to categorize algorithms depending on the level of risk and establish differentiated requirements to ensure transparency, explicability, and accountability of such systems. In the riskiest areas, it is advisable to ban the use of ADM systems. At the legislative level, governments should establish the requirement for reporting by state bodies using ADM systems, as well as introduce a rule on mandatory notification of persons involved in a legally significant decision made by an ADM system that such a decision has been made based on algorithmic processing without human participation, and every person who does not agree with this decision should have the right to challenge it.

The scope of the study is limited by the size of the sample of sources (as we have mentioned, a total of 175 scientific studies were initially used in the study), including monographs, reports, and statistical data. After a careful selection, we selected 52 papers that specifically described the classification and main risks of using ADM systems.

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In further research on the problems of using ADM systems, it is necessary to consider the issues of expanding the scope of algorithms and the main advantages of their use.

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