Research on Risks and Regulation of Intelligent Emergency Management from the Perspective of Algorithmic Governance

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Abstract: *With the progress of algorithmic governance and the continuous development of intelligent technology, emergency management has started to move in an intelligent direction. The three main directions of the internal logic for "algorithmic governance empowerment" in this paper are concept redefinition, technology promotion and demand pulling. It also has some typical use cases and explains the development path. In the future, we will continue to improve the optimisation of algorithm design and increase the transparency of operations to achieve scientific operation and accurate decision-making in emergency management algorithms, thereby providing support for building the emergency management system of Chinese modernisation.*

Keywords: *Algorithmic Governance, Intelligent Emergency Management, Risk Generation, Regulatory Approach, Intelligent Governance*

1. Introduction

With the full arrival of the era of algorithmic intelligence, technologies such as the Internet, Big Data and artificial intelligence have continuously entered all areas of economic and social development. With the progress of algorithms, many changes have recently taken place in the field of emergency management. Algorithms are good at processing data, finding patterns and making intelligent decisions; thus, they can accurately analyse the emergency behaviour and needs of many people, and have gradually become an essential part of building a new emergency management system and changing the traditional emergency management model.

The current emergencies around the world have many attributes: high frequency, large scale and strong interconnectedness. The old emergency management model is not good at collecting information and responding quickly, and it is not well-coordinated. With the continuous progress of the Digital China strategy, many advanced technologies such as big data, artificial intelligence and the Internet of Things have been applied to daily life in emergency management recently. Now we need to correct the old problems and promote the modernisation of the emergency management system and functions by means of intelligent emergency management. Zhong Kaibin (2020)

It is hoped that new technologies will help change the concept of emergency management from passive response to active prevention.

As the foundation of intelligent technology, algorithms are now being applied to solve all kinds of problems in the chain of intelligent emergency response, such as early warning and disaster relief; they can collect and analyze information from all sides of an emergency to help government departments manage the emergency more effectively. With the spread of algorithms in emergency management, many new problems for governance have also arisen. Zhang Aijun and Li Yuan (2019)[2] believe that algorithmic power will naturally expand in the era of artificial intelligence, and without effective constraints, it will be easy to lead to power alienation and unfairness. Lin Huanmin (2022)[3] thinks that automatic decision-making algorithms are unable to distinguish among various levels of risk and will issue unreasonable regulations in uncertain circumstances if applied to the public sector. Emergency management has many public characteristics, so the performance of the algorithm will directly affect technical efficiency and also impact the safety and fairness of society.

Therefore, this paper uses the tool of algorithmic governance to explore the necessary link between algorithmic governance and intelligent emergency management; it categorises all kinds of risks, puts

forward corresponding regulations, and offers some references for the optimisation of emergency management models and an increase in the level of intelligence.

2. Definition of Core Concepts and Theoretical Foundation

2.1 Definition of Core Concepts

2.1.1 Algorithmic Governance

Algorithmic governance refers to the direction, regulation and supervision of the design, development, deployment and application of algorithms by means of technology, institutions and ethics. Promote openness, fairness and the rule of law in the operation of algorithms to prevent all kinds of risks from algorithms. Meng Tianguang and Zhao Juan (2018)[4] believe that the main way to realise algorithmic governance is to achieve coordination and unity between technical rationality and value rationality. The goal of algorithmic governance in the area of emergency management is to regulate emergency algorithms and ensure that they are used scientifically, fairly and efficiently in the assessment of risks, emergency response decisions and other links.

2.1.2 Intelligent Emergency Management

Intelligent emergency management is a new type of management that uses digital technology, such as big data, artificial intelligence and the Internet of Things, to apply algorithms all the time in all links of emergency management, including risk assessment, early warning, response, handling and recovery. Collect and analyse the data, then make a decision and carry out the project in accordance with the model. Wen Zhiqiang and Li Yongjun (2022)[5] believe that the first is to break down departmental barriers and improve the use of resources through technology. Zhang Haibo and Tong Xing (2022)[6] have shown that intelligent emergency management can help to improve the accuracy of risk prevention and control and the efficiency of emergency response.

2.2 Theoretical Foundation

2.2.1 Algorithmic Power Theory

According to the algorithmic power theory, algorithms have gradually taken the form of new power in the digital age and are characterised by concealment, expansion and inequality (Zhang Aijun and Li Yuan, 2019)[2]. At present, algorithms are being employed to solve the problem of emergency management in risk assessment and response decisions. If there are no effective constraints, people will make poor choices and harm the interests of the public.

2.2.2 Algorithmic Administration Theory

The two main contents of the theory of algorithmic administration are its application in administrative decision-making and implementation, and related problems of legal regulation. Wang Huaiyong and Deng Ruohan (2022)[7] have pointed out that although algorithmic administration can improve the efficiency of administration, there are also problems of opaque decision-making and unclear division of responsibilities; therefore, legalisation is needed to address these problems.

2.2.3 Intelligent Governance Theory

Meng Tianguang (2023)[8] believes that the construction of an intelligent governance system requires building a collaborative governance system of "technology plus institutions", and thus it is necessary to properly regulate the relationship between technological empowerment and governance norms to achieve deep integration of algorithmic technology and public governance.

3. Internal Logic of Algorithmic Governance in Intelligent Emergency Management

The three levels of logic in the empowerment of intelligent emergency management by algorithmic governance are conceptual, technological and demand-driven; they correspond to value logic, operation logic and goal logic.

3.1 Concept Reconstruction: Value Logic

In the new era of algorithmic intelligence, new ideas such as "diverse collaboration", "algorithmic

transparency" and "technology for good" have appeared; emergency management has changed from the old way of passive response to active prevention, and it has been transformed from dispersed management to an all-encompassing process management system and from single-subject participation to various collaborative governance (Wen Zhiqiang and Fu Meijia, 2023)[9]. The above idea can help to close the gap between the actual situation and the desired goals of emergency management.

3.2 Technology Driving: Operational Logic

The emergency knowledge system based on algorithms has begun to change the form of emergency management. It will offer the technology for the links of prevention and preparedness, warning release and emergency response. At the same time, it can expand the range of multi-subject emergency knowledge and promote the socialisation of emergency management. The good cooperation of technology and institutions will continue to improve and advance the old emergency management system.

3.3 Demand Traction: Goal Logic

The emergency demands of the new era have been characterised by refinement, convenience and intelligence, so intelligent emergency management has begun to develop in this direction. Algos can collect many kinds of data about all kinds of emergency situations. Algorithms will reduce the information bottleneck and form a chain of "data-information-resources" to improve the efficiency of emergency response. New-generation information technology and algorithms can be employed to transmit and intelligently analyse emergency data accurately for the purpose of intelligent construction.

4. Types of Risks in Intelligent Emergency Management from the Perspective of Algorithmic Governance

The risks in the process of intelligent emergency management can be divided into the three stages of Design, Operation and Application for algorithmic governance in emergency management.

4.1 Algorithm Design Stage: Risks of Value Bias and Technical Defects

The above are the main risks of the "technology-driven" nature of the algorithm design stage. At the level of values, algorithms may contain the subjective judgments of designers, deviate from the orientation of public interest, excessively pursue efficiency and ignore fairness, and thus lead to an unfair allocation of resources (Hou Dongde, 2023)[10]. Artificial intelligence has some technical flaws; that is to say, its algorithms are not very precise or stable, and they cannot be used in complex and changing emergency situations (Zhang Chenggang, 2018)[11].

4.2 The Algorithm Operation Stage: Risks of Black Box Operation and Power Alienation

Algorithmic black boxes are generally not transparent in their decision-making process and do not disclose the data they have processed; thus, there will be a loss of public trust and it will be difficult to determine accountability[12]. If the algorithm does not have good constraints, it will gradually take on the responsibility of emergency decision-making, reduce the scope of judgment for people, and may even result in rigidity or interest problems in decision-making due to technological monopoly (Zhang Aijun and Li Yuan, 2019[2]; Zhong Kaibin, 2020[1]).

4.3 Application of the Algorithm: Risks of Responsibility Vacuum and Lack of Coordination

The responsibility vacuum is that many parties are involved in the use of algorithms, and since there is no clear division of responsibilities, it is difficult to determine who should be held accountable for errors made by algorithms (Wang Huaiyong and Deng Ruohan, 2022[7]; Wang Gui, 2021[13]). The departments do not cooperate with each other, there is information isolation and a lack of data interoperability, and the algorithm standards are not uniform; thus, the whole situation is fragmented (Wen Zhiqiang and Li Yongjun, 2022[5]). There are also serious problems in data security and the protection of privacy; the lack of relevant regulations in the related links may harm public security and the privacy of individuals (Ma Ben and Mao Qingduo, 2015[14]; Jia Kai and Xue Lan, 2021[12]).

5. Regulatory Approaches for Intelligent Emergency Management from the Perspective of Algorithmic Governance

Algorithm governance for intelligent emergency management is now one of the main directions for modernising our country's emergency management system and improving the general level of construction. Algorithms are efficient, but there are also problems of value bias, power alienation and lack of responsibility. The main reasons are that the technical system and the institutional environment are out of date. The Construction of the regulatory path should be based on the general ideas of "technology in institutions, constraining power with institutions, and responsibility within power", and a closed-loop governance system of four dimensions—design, operation, application and multi-subject collaboration—needs to be established.

5.1 Algorithm Design: Value Embedding and Structure Optimization

The Design Stage is a necessary link in the loading of values and the occurrence of technical defects, and its foundation should be the unity of instrumental rationality and value rationality. First, one should establish value references. Set the two criteria of "public interest priority and procedural justice balance", add the normative element of fairness and security as a constraint to the objective function of the algorithm, and integrate it into the basic structure via value-sensitive design. Given that there are various places and groups, we assume that a single system of values will be accepted everywhere. Second, one should enhance model robustness. Given that there is a high degree of uncertainty in emergency situations, even if they are rare and serious, they need to be included in the training data; therefore, adversarial training and transfer learning can be employed to improve the adaptability of the model, and at the same time, a dynamic evaluation and parameter adjustment mechanism should also be established. Third, there should be a participation mode. One should be free from the closed development model of technical experts, build a tripartite cooperation mechanism of "technical experts, emergency management experts and public representatives", and use algorithmic impact assessments to identify and address potential conflicts of interest and technical risks early in the design stage.

5.2 Algorithm Operation: Transparency Mechanism and Checks and Balances of Power

The first objective of the regulations on operation will be to solve the "black box" problem and achieve a dynamic balance between technological strength and human reason. First, an organised and open information disclosure system needs to be established; the necessary parts of the model and parameters should be disclosed to the regulators, explanations of the decision-making process should be given in professional terms, and functional limits and basic rules can be shown visually for the public, thus balancing the demand for supervision with the protection of trade secrets. Second, one should construct an algorithmic power constraint system. Specify the "auxiliary decision-making" position of the algorithms, set up a decision-making chain of "algorithm recommendation - human review - final decision", require human intervention in cases involving the right to life and fundamental rights of property, and keep the right of veto. At the same time, an "algorithm circuit breaker" will be added to manually intervene if the output is too far from the range. Thirdly, the whole process needs to be traceable. At all the main links, such as data input, model invocation and decision output, a complete record should be kept, and through blockchain technology, it needs to be guaranteed that this record is immutable and time-stamped to provide a factual basis for later accountability and judicial recourse.

5.3 Algorithm Application: Norm Construction and Responsibility Allocation

Rules will be released at the time of application to organise the external institutional environment systematically. First, new laws will be introduced. Based on the review of the current laws, we need to study and formulate the Regulation for Emergency Management Algorithms, clarify the technical standards for algorithm access and operation, specify the scope of application, ensure compliance with the Personal Information Protection Law and the Data Security Law, etc. Second, a system of many responsibilities should be built. According to the division of responsibilities by role, it should be decided that designers are liable for product liability, deployers are responsible for operational liability, users are accountable for decision-making liability, and regulators are responsible for supervision liability. All parties will be jointly and severally liable, and there will be cross-claims. Third, the obligation of data governance should be strengthened. In accordance with the principles of "minimum necessity" and "purpose limitation", one should carry out data classification and grading, store and encrypt the data locally, promote the use of privacy-preserving computation, and regularly monitor the

quality of the data. Fourth, a regular compliance assessment will be carried out. Carry out pre-launch safety checks, conduct random inspections in operation, fully investigate all circumstances of any accidents, have third parties conduct professional audits, explore "sandbox regulation" in a controlled environment for innovative tests, etc.

5.4 Governance Structure: Collaborative Optimisation and Ecosystem Construction

Reasonableness of the Governance System Affects the Effectiveness of Algorithmic Governance. Move away from the old model of government leading and build a cooperative system of many functions for all parties. The government should take responsibility for institutional supply, interest coordination and the bottom line. Reduce the number of departments by combining the ethical review and safety assessment of algorithms for procurement evaluation. In order to promote the internalisation of social responsibility by enterprises, both "hard law" and "soft law" should be employed. Build an algorithm ethics office system and strengthen the algorithm insurance and compensation fund. Research institutions need to give more attention to the new development of algorithm fairness and interpretability, spread the results of their research through technical standards, and proactively organise public education on algorithm literacy. Organise official platforms for the public to post their opinions, grievances and suggestions, as well as other information from the people. Help the public better understand how algorithms work and learn to think critically in the process.

6. Conclusion and Prospect

Algorithm governance can be employed to promote the modernisation of the national emergency management system and improve the capabilities of intelligent emergency management. Algos can be used to improve the efficiency of emergency management and increase the speed of emergency response. However, as it has been continuously expanded in all sectors, many problems have also emerged, such as value bias, technical defects, black-box operation, power alienation, responsibility vacuum and poor coordination. The reasons for the risks in the above items are the inherent uncertainty of the technical system, the relatively slow speed of institutional supply, and an ambiguous division of responsibilities among all parties. The three will probably have some effect on each other and will be affected by them in a complicated way.

To address the problems mentioned above, we need to know the sources of risk, build a complete regulatory plan based on "technology", "institution", "ethics" and "many-party collaboration", and achieve harmony between using technology to improve efficiency and maintaining reasonable regulation in order to promote the intelligent development of emergency management in all weather conditions.

With the continuous development of general artificial intelligence technology in the future, more and more applications of algorithms will appear in the field of emergency management, and all kinds of algorithmic risks will become more complex and varied. The following will be the subjects of the next stage of research in algorithmic governance. Increase the combination of technological innovation and ethical research to gradually solve the problems of algorithmic black boxes and algorithmic discrimination. Second, accelerate the organisation of laws, regulations and industry norms to promote the development of algorithmic governance in line with the rule of law and fairness. Third, strengthen the coordination and function integration of all parties to build a governance synergy based on technology, institutions and ethics. Fourth, learn from the experience of other countries and participate in global governance; based on the above foundation, build an algorithmic governance system for emergency management that is suitable for China and has Chinese characteristics. One should continuously improve the intelligent, scientific and precise level of emergency management, provide strong technical support and institutional guarantees for safeguarding the safety of people's lives and property, and maintain national security and social stability.

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