

Big Data-Driven Intelligence-Led Smart Safety Management: Connotation and Research Framework (Postprint)

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Abstract

[Purpose/Significance] In the era of big data and intelligence, security big data and security intelligence have become the main driving forces for achieving smart security management. Therefore, it is of great significance to conduct research on intelligence-led smart security management driven by big data. [Method/Process] Based on analyzing the connotation of security management from an integrated perspective of big data and intelligence, this study organically combines security intelligence with security big data to explore the connotation of intelligence-led smart security management driven by big data. Finally, a research framework for intelligence-led smart security management driven by big data is established. [Results/Conclusions] The study finds that security data and security intelligence are indirect and direct resources for security management, respectively, and that “big data-driven + intelligence-led” is a feasible path and method for achieving smart security management. Meanwhile, regarding research on intelligence-led smart security management driven by big data, its content is rich, research methods are diverse, and it is an emerging research field with great potential.

Full Text

Big Data-Driven and Intelligence-Led Intelligent Safety & Security Management: Connotation and Research Framework

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Abstract: [Purpose/Significance] In the era of big data and intelligence, safety & security big data and safety & security intelligence (SI) have become the main driving forces for realizing intelligent safety & security management (SM). Therefore, studying big data-driven and intelligence-led intelligent SM is of great significance. [Method/Process] Based on an analysis of the connotation of SM from an integrative perspective of intelligence and data, this paper combines SI with safety & security big data to discuss the connotation of big data-driven and intelligence-led intelligent SM, and establishes a research framework for this approach. [Result/Conclusion] The study finds that safety & security data and SI are indirect and direct resources for SM respectively, and that “big data-driven + intelligence-led” is a feasible path and method to achieve intelligent SM. Moreover, research on big data-driven and intelligence-led intelligent SM features rich content and diverse methods, representing an emerging research field with great potential.

Keywords: big data; safety & security intelligence (SI); safety & security data; big data-driven; intelligence-led; intelligent safety & security management (SM)

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1 Introduction

In recent years, as major safety incidents have occurred frequently and safety risks have become increasingly superimposed and complex, safety management has attracted high attention from the state, government, enterprises, society, the public, and academia. The era of big data, the era of intelligence, and the era of high risk have entered the field of safety management at an unprecedented speed, and safety management research and practice are undergoing a major transformation under these grand times [1-5]. However, current research on innovative methods for safety management remains relatively scarce [6-7], with existing methods far from effectively preventing and controlling complex safety risks, let alone supporting the “prevention-first” approach and the intelligent, precise, and personalized safety risk prevention and control in the intelligent era.

In this context, the concept and methods of intelligent safety management [3,5] have gradually been put on the agenda. This approach represents not only a distinct contemporary characteristic of modern safety management but also an important cornerstone for achieving intelligent, proactive, precise, and personalized safety management. For example, the “Opinions on Promoting Urban Safety Development” issued by the General Office of the CPC Central Committee and the State Council on January 7, 2018 [9] emphasized the need to advocate and implement intelligent urban safety management. In summary,

achieving intelligence is an important goal pursued in current safety management and a key direction for its development in the present and future. Precisely for this reason, in recent years, especially with the advent of the big data era, academia has begun to pay attention to intelligent safety management research. For instance, Peng Zhaohua [3] argued that intelligent safety management is a new model for university safety management in the big data era, while B. Wang et al. [5] explored how to use data-driven safety management to achieve intelligent safety management. However, current research on intelligent safety management remains at the conceptual level, with few universal and foundational theoretical studies [3,5]. Meanwhile, intelligent safety management is at a critical stage of transitioning from concept to practice. Therefore, exploring and practicing a set of reliable and feasible ideas and solutions for intelligent safety management has become an urgent new challenge.

In today's big data and intelligent era, data should serve as the foundation and intelligence (intelligence is encapsulated knowledge, while knowledge is open intelligence [10-11]) should be paramount for achieving intelligent management of nations, societies, and various organizations. Similarly, safety big data and safety intelligence have become the main driving forces for promoting safety management reform, innovation, and progress, as well as for realizing intelligent safety management [6,8]. In view of this, this paper theoretically clarifies the connotation of safety management from an integrative perspective of big data and intelligence (the basis for establishing big data-driven and intelligence-led intelligent safety management), organically combines safety big data, safety intelligence, and safety management, discusses the connotation of big data-driven and intelligence-led intelligent safety management, and establishes a research framework to guide future research and practice in this domain.

2 Safety Management from an Integrative Perspective of Big Data and Intelligence

Literally, big data-driven and intelligence-led intelligent safety management represents the organic combination of safety big data, safety intelligence, and safety management. Further examining the logical relationships among the three, safety big data and safety intelligence are the two fundamental bases and driving forces for achieving this approach. Before studying its connotation and research framework, we must first deeply analyze the connotation of safety management from an integrative perspective of big data and intelligence.

From a system safety perspective, the meanings of safety data, safety management, and safety intelligence [8] are as follows: safety data refers to records and descriptions of system safety status and its changing patterns; safety management refers to a series of activities or behaviors aimed at optimizing and controlling system safety status and its changing patterns to ensure system safety within a specific system; and safety intelligence refers to safety information that influences system safety management. However, it should be particularly noted that the meaning of safety intelligence has changed in the big data

environment. In recent years, with the continuous innovation and upgrading of data extraction, mining, analysis, fusion, and processing technologies and means—especially the emergence of big data technologies—data analysis, processing, and management capabilities have been effectively enhanced. Against this backdrop, people have begun to re-examine and understand the transformation relationships among “data-information-intelligence.” In the big data era, building upon the three typical transformation models of data, information, and intelligence (i.e., linear transformation model, pyramid transformation model, and inclusion relationship transformation model [12]), Liu Li et al. [12] proposed two ways to transform data into intelligence: traditional indirect transformation (i.e., “data→information→intelligence”) and newly emerged direct transformation (i.e., “data→intelligence”). In view of this, in the big data era, safety data can be transformed into safety intelligence not only indirectly through safety information as an intermediate product [8] but also directly. In short, safety data can be transformed into safety intelligence through either direct or indirect transformation methods.

Moreover, based on the inclusion relationship among data, information, and intelligence (i.e., “intelligence · information · data” [12]), we can construct a transformation relationship model between safety data and safety intelligence in the big data environment (see Figure 1 [Figure 1: see original paper]). From this, it is evident that the above definition of safety intelligence needs to be revised, and a new definition should be proposed: safety intelligence refers to safety data and information that influence safety management. The English term for safety intelligence is “Safety & Security Intelligence,” and the word “Intelligence” means both “intelligence” and “intelligence (smartness)” [10]. Therefore, safety intelligence itself possesses intelligence characteristics, which become more prominent in the big data environment. Consequently, safety intelligence is the prerequisite and foundation for achieving intelligent safety management.

Figure 1. Transformation model between safety data and safety intelligence in the big data environment

Based on the above meanings of safety data, safety management, and safety intelligence, we can derive the relationships among safety data, safety intelligence, and safety management. Safety intelligence is the direct basis for conducting safety management work, and safety management cannot be separated from the support of safety intelligence. Therefore, safety intelligence is a direct resource for safety management, and safety intelligence work is a direct supporting component of safety management work. Meanwhile, safety intelligence is transformed from safety data, and the value of safety data lies in creating and using safety intelligence. Hence, safety data is an indirect resource for safety management. In other words, safety data is the fundamental resource for safety management—without safety data resources, safety intelligence cannot be obtained, and safety management work cannot be carried out. Therefore, safety data management is one of the main components of safety management work. At the same time, both safety data and safety management focus on

system safety status and its changing patterns, and much safety data (such as safety risk identification and evaluation data) is generated during the safety management process. Thus, safety management is the “carrier” of safety data, and attention should be paid to the collection and utilization of safety data resources generated in safety management work. The relationships among safety data, safety intelligence, and safety management in the big data environment are shown in Figure 2 [Figure 2: see original paper].

Figure 2. Relationships among safety data, safety intelligence, and safety management in the big data environment

Based on the relationships among safety data, safety intelligence, and safety management, combined with the basic elements of safety management, we extract six basic elements of safety management from an integrative perspective of big data and intelligence (i.e., safety objectives, safety problems, safety data, safety intelligence, safety intelligence agencies, and safety management agencies), and after logically systematizing them, construct an integrative model of safety management from the perspective of intelligence and data, as shown in Figure 3 [Figure 3: see original paper]. According to Figure 3, Table 1 briefly elaborates on the basic meanings of these elements from a system safety perspective (the meanings of safety data and safety intelligence have been explained in detail above and are therefore not repeated in Table 1) and explains the relationships among the elements represented in Figure 3.

Figure 3. Safety management model from an integrative perspective of big data and intelligence

Table 1. Meanings of the six basic elements and their interrelationships in the integrative perspective of big data and intelligence

Element	Meaning	Relationship with Other Elements
Safety Objectives	Objectives formulated by the system safety management agency for the safety status the system expects to achieve within a certain period, such as safety performance objectives, safety outcome objectives, safety risk control objectives, and safety culture construction objectives	Safety objectives are generally formulated by safety management agencies (mainly senior safety management leaders) and guide safety intelligence work in safety management. Of course, safety intelligence directly influences the formulation of safety objectives

Element	Meaning	Relationship with Other Elements
Safety Problems	Various influencing factors that cause gaps between expected and actual system safety status. In short, safety problems refer to various system safety influencing factors. Safety problems vary in severity; generally, they refer to relatively serious problems such as safety hazards and safety incidents	Safety management work is oriented toward identifying and solving safety problems, specifically following the clues of excavating and identifying, describing and expressing, analyzing and concluding, and controlling and handling safety problems. Therefore, safety management work and safety intelligence work in safety management must be carried out directly or indirectly around safety problems
Safety Data	Records and descriptions of system safety status and its changing patterns	Safety data can record and describe safety problems, making it the fundamental resource for discovering, analyzing, and solving safety problems. Meanwhile, in the big data environment, safety data can be transformed into safety intelligence through indirect or direct methods

Element	Meaning	Relationship with Other Elements
Safety Intelligence	Safety data and information that influence system safety management	Safety intelligence (such as safety risk identification and evaluation results) focuses on identifying and interpreting safety problems and directly influences a series of safety management activities carried out by safety management agencies
Safety Intelligence Agency	Specialized agencies established within the system to be responsible for safety intelligence work, aiming to provide safety intelligence needed for system safety management. Safety intelligence work generally includes safety data collection, safety data information analysis, safety intelligence production, and safety intelligence application	The goal of safety intelligence agencies is to produce safety intelligence serving safety management work based on collecting, analyzing, and processing safety data. It should be emphasized that in the big data era, the safety data work of safety intelligence agencies (including safety data collection, analysis, and processing) will be further strengthened

Element	Meaning	Relationship with Other Elements
Safety Management Agency	Specialized agencies established within the system to organize and implement safety management work	The main responsibility of safety management agencies is to effectively intervene in and control safety problems using safety intelligence and formulate safety management objectives. In addition to general supporting management activities such as planning, organizing, leading, coordinating, and controlling, safety management work mainly includes three activity contents: safety prediction, safety decision-making, and safety execution

As can be seen from Figure 3 and Table 1, from the integrative perspective of intelligence and data, safety management is a process of interaction, coordination, and influence among the six basic elements in Figure 3, and none of these elements can be omitted. Specifically, safety management aims to achieve safety objectives, is oriented toward safety problems, takes safety data and safety intelligence as important resources, regards safety intelligence agencies and safety management agencies as behavioral subjects, considers safety intelligence work (including safety data work) and traditional safety management work as main work contents, and focuses on effective collaboration among the above six basic elements.

3 Connotation Analysis of Big Data-Driven and Intelligence-Led Intelligent Safety Management

Referring to relevant intelligent management research [13-15], in the context of intelligent safety management, the term “intelligence” has two meanings: (1) As an adjective, it refers to intelligent safety management (specifically including intelligent, automated, autonomous, dynamic, remote, and precise safety management); (2) As a noun, it refers to the safety intelligence needed to achieve intelligent safety management. From an intelligence studies perspective, safety intelligence originates from safety intelligence because intelligence is encapsulated intelligence, and intelligence is open intelligence [10-11]. Thus, from an intelligence perspective, the key to achieving big data-driven and intelligence-led intelligent safety management lies in “activating” safety intelligence into safety intelligence in traditional intelligence-led safety management, thereby releasing the intelligence of safety intelligence and enabling it to play an intelligent supporting role in safety management.

Based on the above analysis and according to the connotation of safety management from an integrative perspective of big data and intelligence, we can explain the basic meaning of big data-driven and intelligence-led intelligent safety management. This approach refers to, under the guidance of the philosophy that

“safety data information is the necessary path to safety, safety intelligence is the essential treasure for achieving safety, and even more the prerequisite and foundation for intelligent safety” [8], taking computational safety science, safety informatics, safety intelligence studies, and safety management science as the core theoretical foundations, and using big data, Internet, cloud computing, mobile Internet, intelligent devices, sensor networks, blockchain, deep learning, artificial intelligence, safety science and technology, and other technologies as the technical foundation. Supported by an intelligent safety management cloud platform system and centered on “data-driven + intelligence-led,” this approach intelligently processes safety big data work, safety intelligence work, and safety management work in safety management to achieve intelligent, automated, targeted, proactive, precise, personalized, efficient, timely, scientific, visualized, and remote safety risk control, thereby improving safety management efficiency and quality. The specific connotation of big data-driven and intelligence-led intelligent safety management is mainly reflected in the following six aspects:

- (1) **From the conceptual perspective**, big data-driven and intelligence-led intelligent safety management = intelligent safety management + (safety big data + safety intelligence). Intelligent safety management is a new trend in the development of modern safety management science and practice, gradually playing a huge value in various safety management works. It aims to improve the intelligence level of safety management systems, making them systems with safety perception, judgment, analysis, selection, execution, innovation, and self-adaptation capabilities, and filling safety management business, services, and activities with intelligence throughout the entire process. Regarding the relationships among safety big data, safety intelligence, and intelligent safety management, safety big data (i.e., massive safety data information) is the fundamental resource for safety management, while safety intelligence is useful safety data information derived from analysis (i.e., safety intelligence is the essential treasure for achieving safety). It is encapsulated safety intelligence, safety intelligence is open safety intelligence [10], and safety intelligence is the direct resource and foundation for achieving intelligent safety management.
- (2) **From the theoretical foundation perspective**, if we consider the disciplinary level and direct relationships, the direct theoretical foundation of big data-driven and intelligence-led intelligent safety management mainly involves four disciplines: computational safety science (the science of using algorithms, big data, cloud computing, blockchain, artificial intelligence, and other new technical tools to better explain safety phenomena and promote safety improvements [16]), safety informatics (the science of studying safety information phenomena and their movement patterns [17]), safety intelligence studies (the science of studying the nature, functions, structure, generation, transmission, and utilization patterns of safety intelligence [18]), and safety management science (the science of studying safety management patterns, exploring safety management methods, constructing safety management models, and achieving maximum safety manage-

ment benefits). Of course, from a macro (indirect) perspective, big data-driven and intelligence-led intelligent safety management involves interdisciplinary theories, knowledge, and methods from multiple disciplines such as safety science, computer science, data science, mathematics, information science, intelligence science, and intelligence science.

- (3) **From the technical perspective**, big data-driven and intelligence-led intelligent safety management involves the in-depth application of new information technologies such as big data, Internet, cloud computing, mobile Internet, intelligent devices, sensor networks, blockchain, deep learning, and artificial intelligence, and relies on new safety science and technologies such as massive parallel safety big data collection technology, intelligent safety monitoring technology (supporting multi-source safety data collection and access), self-learning safety big data and prediction technology (safety prediction based on self-learning fuzzy neural networks, probability prediction of safety incidents, safety risk prediction), safety data assimilation and safety information integration and sharing technology, safety intelligence intelligent perception and identification technology, and safety incident scenario simulation technology. It establishes a unified intelligent safety management cloud platform system (a collection of “storage-type (safety data storage) cloud platform” and “computational-type (safety data processing) cloud platform”) to provide technical and software/hardware support for big data-driven and intelligence-led intelligent safety management.
- (4) **From the methodological perspective**, big data-driven and intelligence-led intelligent safety management = big data-driven safety management methods + intelligence-led safety management methods. Big data-driven safety management refers to using massive safety data information as the resource foundation and producing safety intelligence through safety data collection, mining, modeling, and analysis [5]. Intelligence-led safety management refers to using safety intelligence to guide the entire process of safety management [6]. In the context of intelligent safety management, intelligence-led safety management should particularly focus on leveraging the intelligence of safety intelligence in safety management to achieve intelligent safety management. Thus, big data-driven and intelligence-led intelligent safety management is the organic combination of big data-driven safety management and intelligence-led safety management—their sublation, deepening, sublimation, and goal, as well as their advanced interpretation. The internal mechanism of big data-driven and intelligence-led intelligent safety management is shown in Figure 4 [Figure 4: see original paper]. In short, it involves applying safety big data and safety intelligence to traditional safety management, allowing safety data to play its fundamental resource value in safety management, enabling safety intelligence to play its intelligent supporting value in safety management, making traditional safety management more intelligent, and making safety management

more scientific.

Figure 4. Methodological perspective model of big data-driven and intelligence-led intelligent safety management

- (5) **From the work activity perspective**, big data-driven and intelligence-led intelligent safety management is “intelligent + work activities related to big data-driven and intelligence-led safety management.” The work activities of big data-driven and intelligence-led safety management mainly include three aspects: safety big data work, safety intelligence work, and safety management work. To achieve big data-driven and intelligence-led intelligent safety management, these three aspects of work activities must be intelligently realized. For example, in safety big data work, intelligent acquisition, processing, and analysis of safety data information should be achieved [19-20]; in safety intelligence work, both intelligent safety intelligence perception, analysis, utilization, and feedback should be realized [19-20], and creative intelligence should be used to organize, analyze, and reorganize safety intelligence to form practical value-added safety intelligence products to effectively support the construction of intelligence assurance capabilities and safety management innovation [21-22]; in safety management work, intelligent safety observation, intelligent safety forecasting, intelligent safety decision-making, and intelligent safety execution should be achieved. Therefore, big data-driven and intelligence-led intelligent safety management uses various new information technologies (such as big data, sensor networks, artificial intelligence, and blockchain) as support to achieve intelligent linkage among safety big data work, safety intelligence work, and safety management work, as shown in Figure 5 [Figure 5: see original paper].

Figure 5. Work activity perspective model of big data-driven and intelligence-led intelligent safety management

- (6) **From the objective perspective**, the intelligent safety management model established through big data-driven and intelligence-led approaches aims to achieve intelligent, automated, targeted, proactive, precise, personalized, efficient, timely, scientific, visualized, and remote safety management (the “eleven-ization” of safety management), thereby realizing measurable, controllable, and traceable safety risks, improving safety management efficiency and quality, and truly reducing safety management costs.

In summary, the main characteristics of big data-driven and intelligence-led intelligent safety management are reflected in three aspects: (1) It can achieve deep-level exploration of safety big data, extract useful safety intelligence, “activate” safety intelligence into safety intelligence, provide intelligent support for safety management, and improve the intelligence level and scientific nature of safety management; (2) It can realize automation, precision, and proactivity in safety management, effectively improving safety management quality and

efficiency while reducing human and material costs; (3) It can achieve intelligent monitoring and control of the entire safety management process and all dimensions, ensuring efficient and orderly safety management work. In conclusion, big data-driven and intelligence-led intelligent safety management is an advanced safety management concept and an intelligent, efficiency-enhancing safety management method. Supported by new-generation information technologies, it realizes the intelligentization of safety management, scientifically reconstructs and integrates safety data resources, uses data mining, analysis, and processing tools to intelligently screen valuable safety intelligence services to improve safety management, and enhances safety management efficiency and quality, embodying innovation, intelligence, precision, and efficiency in safety management.

4 Establishment of the Research Framework for Big Data-Driven and Intelligence-Led Intelligent Safety Management

In summary, research on big data-driven and intelligence-led intelligent safety management should take theories and methods from five disciplines—safety science, management science (focusing on safety management science), intelligence science (focusing on safety intelligence studies), data science (focusing on big data science), and intelligence science—as important disciplinary theoretical and methodological foundations. It should be supported by intelligence-led safety management methods, big data methods, and multidisciplinary cross-methods as main research methods, and should establish a big data-driven and intelligence-led intelligent safety management system in the long term. The research framework for big data-driven and intelligence-led intelligent safety management is shown in Figure 6 [Figure 6: see original paper]. The following analysis of the main research contents and methods is based on Figure 6.

Figure 6. Research framework for big data-driven and intelligence-led intelligent safety management

4.1 Research Contents

As shown in Figure 6, the research contents of big data-driven and intelligence-led intelligent safety management mainly include five aspects: basic theoretical issues of the approach, its mechanisms, the safety intelligence service system oriented toward intelligence-led safety management (including the technical support system), influencing factors for implementation, and application empirical research.

4.1.1 Basic Theoretical Issues of Big Data-Driven and Intelligence-Led Intelligent Safety Management Methods

Theoretically, clarifying the basic theoretical issues of this approach is the primary task for conducting research in this area and the foundation for other research contents. This research content mainly includes: (1) The ideas and ad-

vantages of conducting safety management work based on big data and safety intelligence, which have been briefly analyzed in this paper; (2) Analyzing and sorting out the basic issues of this approach, including its connotation, core ideas, theoretical foundation, basic elements, and requirements; (3) The impact of big data on intelligence-led safety management (such as the enhancement of correction and control mechanisms); (4) Principles and methods of applying big data to intelligence-led safety management (such as the mechanism of big data intervention in intelligence-led safety management, and methods for acquiring and analyzing safety intelligence in big data-driven safety management); (5) How to use this approach to achieve intelligent safety management.

4.1.2 Mechanisms of Big Data-Driven and Intelligence-Led Intelligent Safety Management

The mechanisms of this approach constitute the basic basis for its implementation. This research content specifically involves: clarifying the application mechanisms of big data in intelligence-led safety management, and constructing a model for big data-driven and intelligence-led intelligent safety management based on the general process steps of intelligence-led safety management, combined with the inherent connotation, characteristics, and requirements of intelligent safety management and the impact of big data on intelligence-led safety management, to guide relevant research and practice.

4.1.3 Safety Intelligence Service System for Big Data-Driven and Intelligence-Led Intelligent Safety Management

This system includes the technical support system for this approach. Safety intelligence is crucial for intelligence-led safety management. This research content mainly includes: (1) Analyzing the relationship between safety big data and safety intelligence; (2) Clarifying the sources of safety intelligence in safety management under the big data environment; (3) Analyzing changes in the collection, storage, analysis, production, evaluation, and utilization of safety intelligence in big data-driven safety management, and establishing methods, tools, and technical systems for these activities.

4.1.4 Influencing Factors for Implementing Big Data-Driven and Intelligence-Led Intelligent Safety Management Methods

To effectively implement this approach, its influencing factors must be identified. This research content mainly includes: (1) Conducting qualitative and quantitative analyses of influencing factors from multiple dimensions such as resources (e.g., human resources), policies, technologies, and systems; (2) Based on this, proposing targeted and feasible countermeasures and suggestions to overcome current implementation difficulties.

4.1.5 Application Empirical Research of Big Data-Driven and Intelligence-Led Intelligent Safety Management Methods in Relevant Safety Management Fields

Building on the above four research contents, this involves conducting application empirical research on this approach in one or several safety management fields (such as urban safety management).

4.2 Research Methods

Based on Figure 6, the main research methods for big data-driven and intelligence-led intelligent safety management are briefly introduced as follows:

4.2.1 Overall Main Research Methods

These include: (1) Intelligence-led safety management methods and big data methods. As analyzed above, this approach solves current safety management challenges through the organic combination of “intelligence-led safety management methods” and “big data methods” to adapt to the development trends of safety management work in the big data and intelligent era. Therefore, these two are the core research methods. (2) Multidisciplinary cross-research methods. As can be seen from the involved disciplinary theories and methods, this approach is a multidisciplinary cross-research issue involving safety science, management science, intelligence science, data science, and intelligence science. Therefore, multidisciplinary cross-research methods are the main research methods.

4.2.2 Specific Key Research Methods for Each Content Module

These include: (1) Research on basic theoretical issues mainly uses theoretical speculation, literature analysis, and comparison methods (such as comparing this approach with traditional safety management methods); (2) Research on the model mainly uses theoretical modeling methods (the intelligent safety management model belongs to theoretical models), logical methods (logical rigor and clarity are key to modeling), big data methods and technologies, and intelligence science methods (how to make the model achieve intelligent safety management involves intelligence science knowledge and methods); (3) Research on the safety intelligence service system mainly uses big data methods, intelligence acquisition and analysis methods, and survey interview methods (this research is oriented toward actual safety management work, so survey interviews are also key); (4) Research on influencing factors requires survey interview methods for identification and qualitative-quantitative combined analysis methods for factor analysis; (5) Application empirical research mainly involves empirical methods and survey interview methods.

5 Conclusion

Developing intelligent safety management is not only a distinct contemporary characteristic of safety management modernization in the big data and intelligent era but also an important cornerstone and fundamental approach for achieving the “eleven-ization” of safety management. Based on the deep integration of safety science, management science, intelligence science, data science, and intelligence science, this study organically combines big data and intelligence-led

safety management, proposes the big data-driven and intelligence-led intelligent safety management approach, and studies its connotation and research framework. This study provides a feasible path and method for achieving intelligent safety management, laying a basic theoretical foundation and providing effective methodological guidance for future research and practice in this domain. Of course, this study is the opening work of the author's Ministry of Education Humanities and Social Sciences Research Youth Fund Project "Research on Big Data-Driven and Intelligence-Led Intelligent Safety Management Methods and Their Empirical Studies." Big data-driven and intelligence-led intelligent safety management is a vast topic, and this study is only a preliminary exploratory discussion, having built a research framework at the macro level. More scholars need to conduct in-depth research around this framework to make this approach a reality.

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Abstract: [Purpose/Significance] In the era of big data and intelligence, safety & security big data and safety & security intelligence (SI) have become the main driving forces to realize intelligent safety & security management (SM). Therefore, it is of great significance to study big data-driven and intelligence-led intelligent SM. [Method/Process] Based on analyzing the connotation of SM from an integrative perspective of intelligence and data, and by combining SI with safety & security big data, this paper discusses the connotation of big data-driven and intelligence-led intelligent SM. Meanwhile, this paper establishes a research framework for big data-driven and intelligence-led intelligent SM. [Result/Conclusion] Results show that safety & security data and SI are indirect and direct SM resources respectively, and “big data-driven + intelligence-led” is a feasible path and approach to realize intelligent SM. Moreover, big data-driven and intelligence-led intelligent SM has rich research contents and diverse research methods, making it an emerging research field with great potential.

Keywords: big data; safety & security intelligence (SI); safety & security data; big data-driven; intelligence-led; intelligent safety & security management (SM)

Note: Figure translations are in progress. See original paper for figures.

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