Construction of Emergency Dispatching System under the Background of Smart City with Big Data

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Abstract. With the continuous development of global technology, the number of smart cities is also increasing. The development of these cities is also accompanied by constant emergencies. Big data technology provides us with a way to optimize the city's emergency dispatch system. In the context of smart city, it has become a trend to combine big data technology to construct emergency dispatching system. The key points of this article are the interrelation of emergency call areas and coordinated dispatch between smart cities. This paper studies possible games between different cities and proposes optimization methods. According to the processing process of material demand information flow, an emergency dispatching system framework of four parts, namely the requirements layer, the information layer, the session layer and the send layer, is constructed to provide reference for the practice of emergency management.

Keywords: Smart City, Emergency Dispatch, Game Analysis, System Construction

1. Introduction

With the rapid development of urban informatization, smart city has become a new concept and practice of modern urbanization worldwide. It has become the development requirement of modern society to use big data technology, Internet of things technology and cloud computing technology to collect, analyze and integrate data to obtain effective information. At the same time, frequent disasters are also threatening people's life and property security, and the timely supply of emergency supplies after disasters is a crucial factor to ensure people's survival after emergencies. Therefore, under the background of smart city, it has
become a modern research hotspot to comprehensively collect, mine and analyze demand data of disaster areas through big data technology to obtain effective information and build an emergency scheduling system that can respond quickly.

2. Research Status of Emergency Dispatching in Smart Cities
Yu Liying, Su Chenpeng et al. [1, 2] analyzed the evolution mechanism of multi-agent system of urban disaster, providing theoretical support for the construction of cooperative model and mechanism of disaster reduction and prevention. Nancy Silvestri [3] provided New York City as an example, and provided a new method to establish urban public information system. Ghosh [4] and others used the Markov radius model to analyze the emergency process of earthquakes in smart cities.

In inter-city scheduling research materials, such as Xu Shengming et al. [5] studied emergency material dispatching in gas explosion accidents and constructed a multi-objective emergency material allocation model under multi-constraint conditions. Palmieri, Francesco et al. [6] proposed a hybrid cloud architecture for managing the computing and storage resources required for command and control activities in emergency situations to better perform inter-city scheduling. Song Xiaoyu [7] for multiple levels of nonlinear continuous consumption emergency supplies scheduling problem, at the lack of material loss minimum and supplies scheduling with target of minimizing the total cost, build by a multicenter, multi-tiered, frequency distribution, the mode of transportation, can transport emergency supplies scheduling model. Liu Jiaguo et al. [8] established a cooperative emergency inventory model to cope with supply disruptions. In terms of scheduling optimization,

Ling Bintao et al. [9] based on the development of big data, Internet and Internet of things technology, constructed the material reserve supply model of emergency logistics and the information management platform of emergency logistics. Wang Zhiyang et al. [10] proposed that big data technology needs to support accurate monitoring and early warning in advance, rapid decision-making, response and efficient disposal in the event, rapid recovery after the event, timely release and guide information dissemination and public opinion.

According to the research status at home and abroad, there are few relevant studies on the emergency dispatching system based on big data under the background of smart city. This study is meaningful and can provide reliable support for emergency management response and decision-making.

3. Construction Principles of Emergency Dispatching System
The definition of big data is not yet unified. The big data technology mentioned in this article refers to information and resources in various stages and areas of emergency material distribution. Including emergency monitoring and early warning data, emergency resource data, emergency knowledge data, and data resource utilization technologies that implement data monitoring analysis, knowledge sharing, and resource search and deployment.

3.1 Precautionary Principle
Before the accident did not happen to be "ready" state of emergency, the existing emergency rescue equipment, supplies and emergency monitoring and early warning system to do full check ahead of time is strong, strong guarantee for sudden disasters, in the event of accident, do immediately response and in the "standby" state rescue equipment, supplies and rescue workers.

3.2 Disposal Principle
The handling of accidents is particularly important. When an accident is unavoidable, the government's top priority is to control the deterioration of the incident and minimize human casualties and property losses. Scientific emergency plans, professional rescue organizations, and scientific command and decision-
making are important guarantees for successful handling of incidents. The use of big data analysis to form the optimal solution to control the deterioration of events, reduce rescue costs and improve rescue efficiency.

3.3 Post-event Recovery Principle
The post disaster planning and reconstruction work is an important guarantee for the recovery of the mood, quality of life and local economy of the victims. After the crisis situation is under control, the government will carry out post-crisis recovery and reconstruction, accountability, public psychological comfort and confidence recovery, prevent the recurrence of the crisis, and change the government management system. Through big data technology monitoring, the secondary disaster can be well prepared for the recovery and reconstruction of the disaster area.

3.4 Post Control Information Principle
After the accident, all kinds of media will report relevant information at the first time. Benign information dissemination can satisfy the public's right to know, but if the spread of false information is not controlled, it will cause public panic and social chaos.

4. Analysis of Emergency Dispatching System of Two Smart Cities

4.1 Emergency Dispatching Game between the two Smart Cities
In order to analyze the impact of smart cities with different levels of data technology on disaster emergency dispatching, this paper constructs the inter-governmental cooperation model of disaster emergency dispatching under the background of smart cities, and makes the following assumptions. It is assumed that the disaster emergency dispatching system of smart city is composed of smart city local government A and B. When urban disasters occur, cities with high efficiency in emergency decision-making with big data technology can respond quickly, organize emergency response and rescue work in a timely manner, and reduce urban disaster losses. The input of smart city government A and smart city government B to the big data technology of urban smart emergency management is $\text{Ca}$ and $\text{Cb}$ respectively. The cost of rescue after an emergency is $\text{Ia}$ and $\text{Ib}$ respectively. The maximum loss caused by disasters in areas A and B is $\text{La}$ and $\text{Lb}$, that is the loss when no rescue action is taken. Both big data technology input and rescue input cost are $\partial$, which means that the input of $\text{Ca}$ can reduce the maximum loss of $\partial\text{Ca}$.

In addition, when A uses big data technology, it will generate $\beta\text{Ca}$ rescue help for B. when B uses big data technology, it will generate $\beta\text{Cb}$ rescue help for A. $\beta$ is the incidental assistance coefficient. It is assumed that the city size, technical importance and rescue difficulty of smart city A are greater than that of smart city B, that is, $\text{La} > \text{Lb}$, $\text{Ca} > \text{Cb}$, $\text{Ia} > \text{Ib}$.

Both A and B have the possibility of "Using" and "Not Using" big data technology in the face of emergency scheduling. The possibility of different choices of both sides constitutes the game. The following table is the game analysis.

| Smart City A | Using | Not Using |
|--------------|-------|-----------|
| **Using**    | $U_{11}(A), U_{11}(B)$ | $U_{12}(A), U_{12}(B)$ |
| **Not Using**| $U_{21}(A), U_{21}(B)$ | $U_{22}(A), U_{22}(B)$ |

$U_{11}(A) = \text{La} - \partial(\text{Ca} + \text{Ia}) + \text{Ca} + \text{Ia} - \beta\text{Cb}$

(1)
\[ U_{11}(B) = L_b - \partial(C_b + I_b) + C_b + I_b - \beta C_a \]  
(2)

\[ U_{12}(A) = L_a - \partial I_a + I_a - \beta C_b \]  
(3)

\[ U_{12}(B) = L_b - \partial(C_b + I_b) + C_b + I_b \]  
(4)

\[ U_{21}(A) = L_a - \partial(C_a + I_a) + C_a + I_a \]  
(5)

\[ U_{21}(B) = L_b - \partial I_b + I_b - \beta C_a \]  
(6)

\[ U_{22}(A) = L_a - \partial I_a + I_a \]  
(7)

\[ U_{22}(B) = L_b - \partial I_b + I_b \]  
(8)

Its game model conforms to the "Boxed Pig Game". It can be seen from the game results that, for smart city B, choosing not to use big data technology is its dominant strategy. For smart city A, if it does not use technology, it will suffer more losses, so the equilibrium of the game moves towards (using, not using). However, in emergency dispatch, the ideal equilibrium we expect is that both parties use technology to create greater common benefits. Therefore, the central government needs to provide compensation or incentive mechanisms for cities A and B to make the game move to the equilibrium used by both parties.

4.2 Conclusions and Optimization Methods

Through the above analysis, the following conclusions can be reached:
(1) In the game, the size of the city determines the city's position in the game, and the degree of disaster emergency input to the smart city is affected by this;
(2) Relatively weak cities tend to choose conservative strategies to reduce their total losses, and the two sides cannot form the expected equilibrium under natural conditions;
(3) Special government subsidies can effectively encourage local governments to make more efforts to reduce the disaster losses of various cities, and encourage vulnerable cities to invest more technology costs, so as to shift the balance to both sides.

If the equilibrium is moved towards the use of big data by both parties, it can rely on the government's ability to influence and govern, and combine scientific innovation with the actual situation in the region. Based on the above analysis, the following optimization methods are proposed.

- Improve the government's ability to influence and implement smart cities. On the one hand, intelligent emergency courses are offered in colleges and universities to gradually cultivate talents with intelligent technology and emergency management professional quality. On the other hand, by regularly organizing professional training and special education, strengthening the theoretical knowledge training of the management, and constantly improving the understanding and understanding level of emergency management and decision makers on intelligent emergency.

- Establish an information center deeply integrated with the smart city. Plan the materials, funds, and information that smart cities can use to respond to disasters, and ensure the orderly mobilization of resources and low-cost requirements.

- Establish a reasonable cost-sharing mechanism. We will increase emergency investment in smart cities, adjust the financial mechanism, and make smart cities more integrated. At present, the pilot cities in China have explored the construction path of smart cities spontaneously, aiming at the best interests of the local government and ignoring the cooperation and interconnectivity. The central government should give full play to its steering role and establish and improve smart city disaster funds, social insurance and social assistance through agreements and contracts. We will promote inter-regional emergency response coordination.
5. Construction of Emergency Dispatching System

According to the construction principle of emergency dispatching system, this paper constructs the framework of emergency material dispatching system in four parts: requirements layer, information layer, session layer and send layer.

5.1 Requirements Layer

Smart city is the application of new generation information technology such as Internet of things, cloud computing and geographic space, as well as tools and methods such as wiki, social network, Fab Lab, Living Lab and network omnimedia fusion communication terminal. And the use of these covers all aspects of a new generation of information technology in the city, such as visual collection and identification, all kinds of sensors, wireless positioning system, RFID, top technology such as visual tags. These can quickly learn the situation of each affected site after the disaster, and collect these demand information for analysis, which can further optimize the scheduling.

5.2 Information Layer

- Information acquisition. Information resources refer to all kinds of information resources that can support emergency management and decision-making. After the incident occurred, can use wisdom to urban environment any normal operation deployed in all areas of the video monitoring system, image acquisition system, global positioning system (GPS), geographic information system, wireless network technology, microelectronics sensors, mobile devices, industrial system, through a variety of wireless or wired long distance or short distance communication network connectivity, providing personalized real-time on-line monitoring, safety control and positioning traces.

- Information processing. The acquisition of information is often accompanied by a large number of data sets of different forms. For different data structures obtained through different channels and collection methods, big data technology is used to gather the information together to form a data set with a unified format and for a variety of data applications, which provides convenience for later analysis.

- Information storage. In the process of emergency management, it is necessary to collect and mine massive data in real time, so a large number of data resources will be generated. In the era of big data, cloud storage has become an emerging solution. The obtained data is stored by cloud storage technology and data analysis is continued.

- Information analysis. The demand information in the disaster area after processing is collected on the cloud computing management platform, and the data analysis technology converts the data into useful information and knowledge that are urgently needed to provide data support for the rescue.

- Information sharing. Intelligence information sharing is divided into two levels. The first level is the sharing of different emergency information; the second level is the information sharing of intelligence centers at all levels, including horizontal and vertical information sharing.

5.3 Session Layer

For the data that has been analyzed, feedback to the government responsible person, and interact with the affected areas to supplement the analysis results. This paper is divided into emergency interaction and normal management interaction. The interaction in the emergency state is mainly reflected in the supplement of the collected and analyzed information to better complete the precise rescue. The interaction under normal management mainly reflects the supplement to the daily emergency preparedness.
5.4 Send Layer
For the information application that will be collected and analyzed and interactive, precise dispatch of materials and personnel required by each disaster site. This paper is divided into emergency dispatch and dispatch under normal management. The application in the emergency state includes resources through the database, dispatching and dispatching of the rescue personnel, adjusting the rescue strategy timely through the acquisition of real-time information, and real-time reporting of the progress of emergencies by media departments to prevent public opinion panic. The dispatching under normal management is mainly reflected in the feedback of the public, experts and other subjects on the local hidden trouble information, and the dispatching of professional personnel to take precautions in advance to eliminate hidden trouble. In addition, in the process of normal management, simulation drills can be conducted based on the historical data, intelligence assessment, and emergency warning.

![Figure 1: Framework of emergency material dispatching system in four parts](image)

**Figure 1** Framework of emergency material dispatching system in four parts

**Conclusion**
In the context of big data in smart cities, with continual emergencies, smart emergency response is an essential component. Among them, the emergency dispatching system is an important support system in the emergency process. Building a flexible, scientific, reliable, and fast response emergency dispatching system is the only way to effectively respond to various types of emergencies. This article summarizes the principles of constructing an emergency dispatch system in the context of big data. This article summarizes the principles of constructing an emergency dispatch system in the context of big data. It also analyzes the possible games and optimization methods of the emergency dispatch system constructed by multiple smart cities, and proposes policy recommendations. Finally, an emergency dispatching system model under the background of smart city big data can be constructed, which can provide theoretical support to relevant departments and provide reference and reference for emergency management practice.
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