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Virtual public reserve guarantee mechanism for emergency supplies in the post-epidemic era

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Abstract: *To realize the accurate reserve and timely supply of emergency materials, influenced by the idea of intelligent storage and intelligent material linkage, considering the complexity, uncertainty, and dynamism of disasters, and because of the national demand for the allocation of living materials, based on the study of the "ordinary and emergency integration" collaborative adaptation mechanism of materials, a kind of This is a virtual reserve mechanism that is "complementary in times of peace and dominant in times of emergency". With the help of big data and other means, the mechanism ensures the reasonable distribution of supplies while improving the efficiency of distribution. In contrast to the traditional way of establishing reserve warehouses, under the normalization of epidemics, this model is based on "prevention" and combines "peace" and "emergency", which is conducive to achieving a balance of storage resources. It reduces the waste of storage resources and saves storage costs. It helps to ensure the efficient supply of emergency supplies in the event of a normal epidemic.*

Keywords: *Virtual mass storage, Flat emergency transformation, Data sharing, Emergency logistics*

1. Introduction

Public health problems pose a great threat to people's lives and health and safety, and with the normalization of epidemics, how to stockpile and deploy emergency supplies effectively is a pressing issue at the moment.

General Secretary Xi Jinping stressed that "emergency management is an important part of the national governance system and governance capacity, assuming the important responsibility of preventing and resolving major security risks, responding to and dealing with all kinds of disasters and accidents on time, and undertaking the important mission of protecting the lives and property of the people and maintaining social stability." From the central to the local level, a high degree of importance is attached to the emergency supplies reserve system.

The reserve and deployment of emergency supplies are directly related to the vital interests of the people, and it is important to continuously optimize the reserve deployment plan and explore a reasonable emergency supplies guarantee system. Unlike the traditional way of establishing physical reserve warehouses, virtual reserves can break through the original geographical limitations of reserves and achieve "level-emergency conversion" according to different needs, with more prominent advantages in terms of low cost, excellent layout, and high synergy.

2. Literature review

The management of emergency supplies reserves based on big data, such as virtual reserves and emergency logistics, has been a hot topic of interest for scholars at home and abroad in recent years, and scholars have devoted themselves to exploring how to combine the power of government and civil society to provide a more scientific solution to the way of supplying emergency supplies when disasters occur. At present, China has formed a three-level government emergency supplies reserve system at the central, provincial (autonomous regions, municipalities directly under the central government), and municipal (county-level cities) levels[1]; from the practical point of view, the number of emergency supplies reserves is small and unevenly distributed, which is difficult to meet the requirements of disaster preparedness and relief in the new era[2]; for emergency supplies that are not easy to keep for a

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long time or are in great demand, agreements or emergency procurement contracts can be signed with manufacturers This can facilitate the production and transfer of materials after emergencies, and improve the management of emergency materials reserves by making use of the strength of all parties to obtain emergency materials [3];

3. Virtual mass storage mechanism

3.1 The concept of virtual storage

Virtual storage, with six characteristics of virtual, emergency conversion, synergy, dynamic diversity, and personalization, is more systematic information management of materials in different geographical locations through IoT big data, to ensure that decision-makers can carry out unified management and dispatch of materials, to achieve the efficient use of materials, to achieve the adequacy and rationality of reserves; the diversity and balance of the types of materials stored; the low cost and high efficiency of materials The model of low cost and high efficiency in the process of stockpiling and emergency distribution, and high satisfaction of the affected people in the distribution results.

3.2 The framework of virtual storage

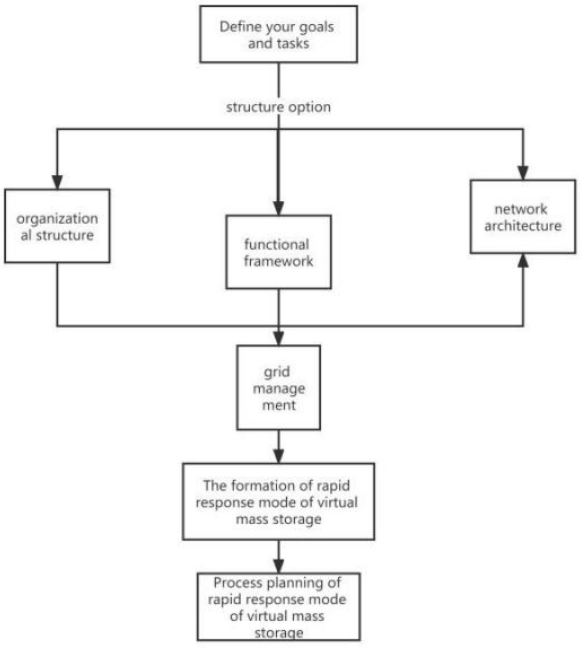

Figure 1: The virtual mass storage run framework.

Figure 1 is the virtual mass storage run framework. Virtual crowd storage refers to the use of virtual reality technology, usually the use of big data, the Internet of Things, and other technologies to achieve information resource sharing, the establishment of a rapid response mechanism, and the specific establishment of the framework. The organizational structure is mainly discussed around the storage structure; the functional structure is mainly around the functions of each level of crowd storage points; different network structures need to be selected according to different needs. Grid management means that the emergency materials distributed throughout the society are divided into corresponding grid units according to certain standards so that the command center can better manage the materials.

3.3 Rapid response operation mode

(1) Virtual mass storage "usual" reserve mode

The virtual storage mode is the use of network communication and other technologies to store and remotely control items belonging to different subjects and centralize the management of inventory

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information through an information-sharing platform. In the event of a major public health incident, the local area will be the "first port of call" for emergency response.

In terms of performance, to support the normal workload, it is important to provide the necessary virtual storage network performance to reduce the negative impact of the virtualization process; in terms of resilience and availability, the virtual storage solution should improve availability, build a comprehensive data protection and fault tolerance mechanism to reduce service interruptions and prevent data loss; in terms of security and compliance, each storage site needs to put security and compliance in the first place. In terms of security and compliance, each CrowdStore needs to put security and compliance at the forefront.

Virtual CrowdStore tools should always protect data. In terms of management and monitoring, the command center must manage and monitor all the storage points in its virtual storage architecture, increasing the level of trust between them. At the same time, providing administrators with the visibility and sense of control needed to maintain systems, perform upgrades, manage data and obtain alerts on problems to maximize the benefits of local rescue.

(2) Virtual Crowd Storage "emergency" response model

Using advanced information technology such as the Internet of Things and big data, we can fully integrate emergency supplies from different regions, improve the emergency supplies reserve system "usually supplemented by emergency", realize the balanced layout and virtualized management of the emergency supplies reserve, establish virtual mass storage through the information platform to ensure the supply of emergency living supplies, and provide a more comprehensive and coordinated response for This will help the research on the integration of life materials and emergency coordination and adaptation.

3.4 Operational framework of the rapid response model of virtual mass storage

(1) Establishing a coordination mechanism and unified dispatching mechanism

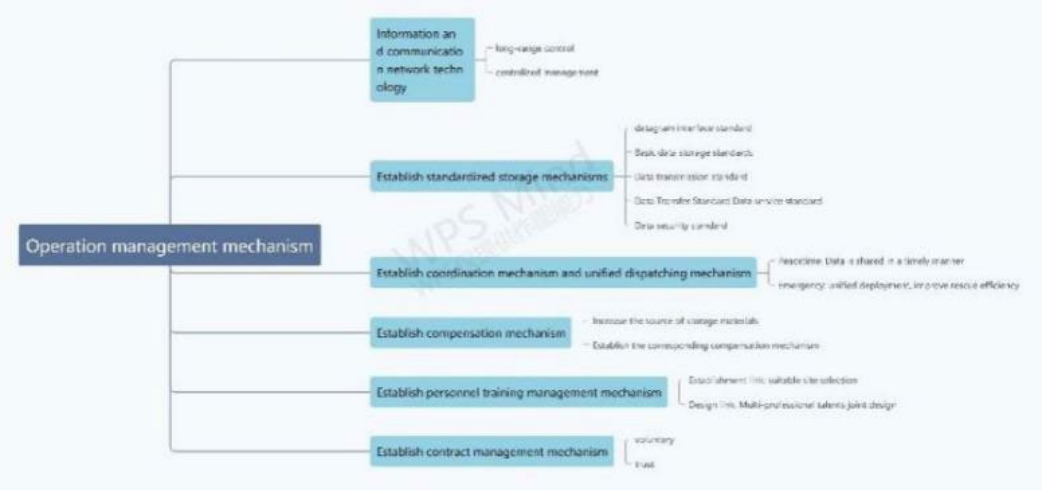

Figure 2: Operation management mechanism.

Figure 2 shows the operation management mechanism. The coordination mechanism runs through the whole cycle of the establishment and operation of the virtual crowd storage, and the establishment of the coordination mechanism is the guarantee for the establishment and operation of the virtual crowd storage. During the establishment phase of the virtual storage, it is required that each storage site can communicate well and cooperate to complete the overall work; during the daily operation phase, it is required that the data sharing, supervision, and management among the storage sites are realized, to realize the timely replenishment and deployment of emergency supplies and ensure sufficient emergency reserves; during the emergency phase, each storage site is unified by the emergency command center to carry out emergency rescue and relief with the help of advanced network technology. Improve the virtual crowd storage rate, reduce emergency rescue losses and improve emergency rescue efficiency.

(2) Establishing an emergency conversion mechanism

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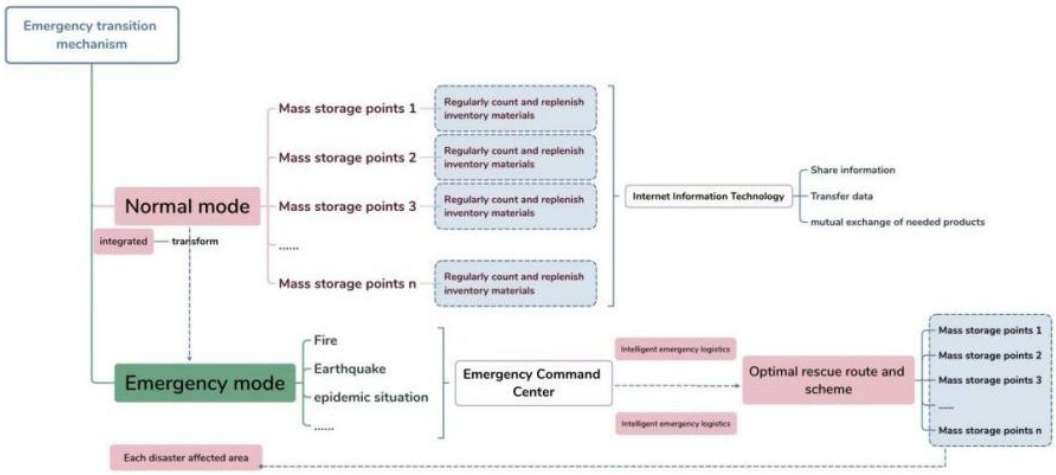

Figure 3: Emergency conversion mechanism.

Figure 3 reveals the emergency conversion mechanism. In normal times, each storage site must do a good job of daily storage management, real-time information sharing, and data transmission to ensure the safe storage of emergency materials; when a disaster occurs, it can quickly switch to emergency mode and be dispatched by the command center to build an intelligent emergency logistics model, quickly develop a reasonable and optimal rescue path and emergency material rescue plan, and deal with disaster rescue in a fair, reasonable, efficient and low-consumption manner. The realization of the level-emergency conversion mechanism can reduce misallocation losses, improve distribution efficiency, guarantee fair distribution, and improve effective solutions for future disaster prevention and control distribution problems.

3.5 Virtual mass storage rapid response mode operation process

(1) Establishing a standardised storage mechanism

The establishment of virtual storage needs to integrate a large amount of data from multiple industries, multiple departments, multiple storage points, and multiple emergency materials. To ensure the seamless connection, integration, and real-time sharing of data information, it is necessary to establish a data standardization system to realize the integration, access, and sharing between the data layer of each storage point and the virtual data warehouse layer of the emergency coordination command and dispatch center, and to ensure the access, application and migration between the virtual data warehouse layer and the application layer. The mechanism is shown in Figure 4.

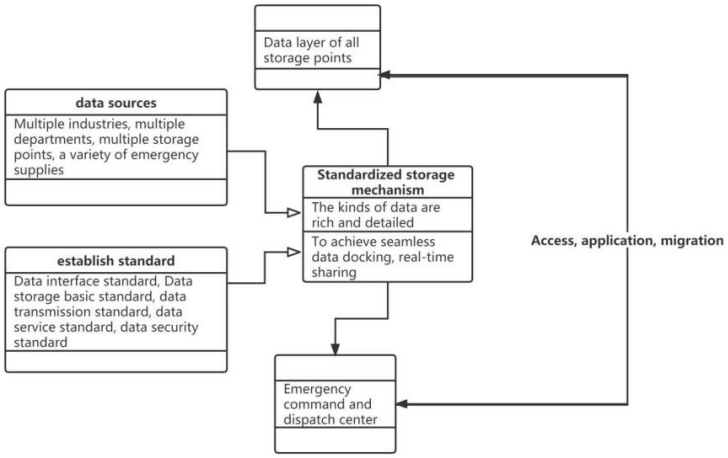

Figure 4: Standardized storage mechanism.

(2) Establishment of compensation mechanism

In addition to government reserves, virtual public storage increases social reserves and actively uses resources from all sides of society to reserve existing social resources, to guarantee the timely supply of

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emergency supplies while saving costs. At the same time, the relevant compensation mechanism is formulated to mobilize the enthusiasm of each storage body and guide it to assume more social responsibility.

(3) Establishing a personnel training management mechanism

The establishment, operation, and maintenance of virtual mass storage and other related aspects need to be completed by relevant professional and technical personnel. A relevant personnel training management mechanism is established on time to mobilize the enthusiasm of the professional team and enhance the sense of responsibility by training them in terms of technology, trust, communication, and cooperation.

(4) Establishment of contract management mechanism

The contract is a sharing and cooperation relationship formed based on voluntariness and trust among all levels of crowd storage points in the virtual crowd storage, which requires each member to fulfill the provisions of the contract to ensure that they can bring their maximum effectiveness in times of peace and emergency. The resources are shared and managed and dispatched by the command center to meet the needs of both usual operations and emergencies. The mechanism is shown in Figure 5.

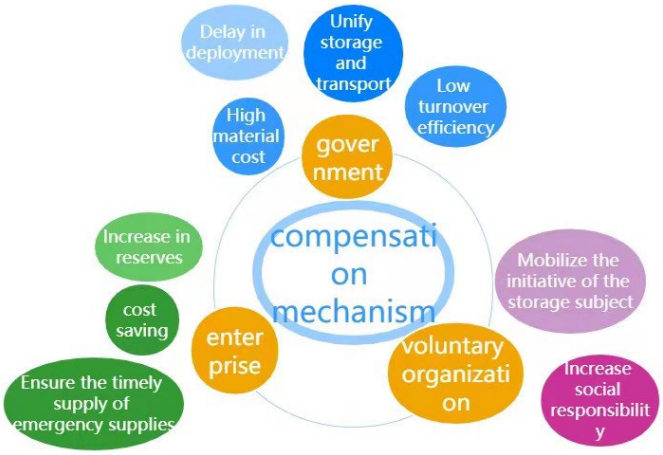

Figure 5: Compensation mechanism.

3.6 The functional structure of the virtual crowd storage rapid response model

In the usual state, the local emergency command center is responsible for the management, supervision, and inspection of the centralized crowd storage sites in the local area, and regularly organizes personnel to conduct random checks on the filed decentralized crowd storage sites, and promptly removes the sites that do not meet the standards of emergency needs, and the centralized crowd storage sites are responsible for the management, supervision, and inspection of the corresponding decentralized crowd storage sites. With the help of a big data platform, resources are shared between the centralized and decentralized CrowdStore sites. In emergencies, the local emergency coordination and command center is responsible for the unified dispatch and management of the centralized crowd storage points, and the centralized crowd storage points are responsible for the unified dispatch and management of the decentralized crowd storage points following the unified requirements of the emergency coordination and command center. After the rescue is over, performance assessment, material settlement and compensation will be carried out for each Crowd Storage site according to the pre-determined uniform standards. The application of the virtual mass storage rapid response model allows for the integration of emergency resources scattered throughout the community to form a reserve of emergency supplies that meets the needs of the region, thereby improving the efficiency of the distribution and transportation of relief supplies and achieving the goal of rapid relief. The realization of virtual mass storage requires the storage of emergency supplies from different owners, with the help of a big data analysis platform, the storage of information from different mass storage points, and real-time transmission and sharing, to achieve effective integration and management of resources.

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4. Analysis of advantages and disadvantages

4.1 Advantages

(1) Enriching the variety of emergency materials and reducing the cost of material storage.

Virtual crowd storage can realize the integration of different storage subjects (enterprises, electric businesses, voluntary organizations, families, individuals, etc.) and solve the problem of a single type of emergency supplies reserve in multiple ways. In addition, it is difficult to guarantee the quality of some relief materials with a short storage period by relying only on national reserves. A virtual public stockpile can not only ensure the quantity and quality of emergency products but also realize the "leveling of emergency products", reduce the cost of storing emergency products and improve the efficiency of emergency material deployment.

(2) Optimise the balanced layout of national emergency supply reserves.

At present, there are 19 central emergency supplies reserves across the country, but there are still relatively few reserves in the western region. Due to the high suddenness of the epidemic, it is necessary to optimize the layout of reserve depots around the country to achieve a balanced allocation of emergency supplies and ensure the efficient arrival of relief supplies. Therefore, it is necessary to make full use of social resources through a variety of reserve methods, to realize the combination of government reserves and social reserves, to realize the combination of physical reserves and virtual reserves, and to establish an intelligent, integrated, and efficient emergency supplies reserve system.

(3) Accelerate the coordination and adaptation of rescue materials to achieve rapid and accurate rescue.

With the help of big data, the Internet of Things, and other technologies, virtual storage can integrate the existing materials in each reserve, establish a Spatio-temporal virtual data warehouse, and realize the sharing of information resources among the various storage points. Through the coordination and sharing mechanism, the reasonable allocation of materials can be achieved. In the event of a disaster, the emergency command center can unify the deployment of materials from various storage sites to reduce the waste of resources and improve the efficiency of resource allocation.

(4) Optimise the type of material reserves to meet geographical needs.

The national stockpile is generally only for general emergency supplies and cannot take into account regional needs. In contrast, virtual storage is the integration of emergency materials from all over society, and the diversity of the main bodies of the storage points makes the materials stocked more diverse, which can meet the needs of people in different regions to a greater extent and make the deployment more scientific and reasonable.

4.2 Disadvantages

(1) Difficult to supervise

The virtual mass storage mode requires the effective integration and sharing of emergency materials information stored in different subjects and different spaces, to achieve the effective integration and efficient use of emergency materials. Because of the diversity of the virtual storage subjects, it is difficult to manage the direction, and if the supervision is unfavorable, it may lead to the emergence of problems such as "there are no goods in the library" and "there are numbers without goods".

(2) High management costs

The establishment of a virtual storage mode requires the integration of a large amount of data from multiple industries, multiple departments, multiple storage points, and multiple emergency materials, and requires the establishment of a standardized data system. To ensure the authenticity and real-time sharing of data information, the special technical personnel are required to manage and maintain the platform, which will incur high management costs.

(3) High data transmission requirements

The virtual storage mode has completed the large-scale integration of data by virtualizing the storage of material information, while also centralizing the storage data from each independent storage point to the information-sharing platform, which has greatly increased the difficulty of data transmission.

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(4) Challenges in putting the system into use

The centralization of materials from various storage sites onto the information-sharing platform is accompanied by an obvious cost increase. Virtual servers are usually big consumers of storage resources. The already high cost of the information-sharing platform itself, coupled with the added investment for dedicated connectivity equipment, makes it more expensive to put into use on a large scale.

5. Conclusion

As a new way of storing and managing emergency supplies, virtual mass storage, with the help of big data, the Internet of Things, and other intelligent means, can realize integrated management and dispatching of relevant supplies in different times and spaces through remote control, which greatly simplifies the process of emergency supplies deployment and is conducive to realizing "flat emergency conversion This greatly simplifies the process of emergency supplies deployment, helps to realize the "level-emergency conversion", reduces the loss of misallocation, has positive significance in the effective use of resources, can effectively solve the problem of untimely supply of supplies, and plays an important role in the accurate distribution of living materials and the timely and effective implementation of rescue activities.

Acknowledgments

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