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Analysis of Military-Civil Interaction in Emergency Management based on C2 Model

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Abstract. In recent years, with the frequent occurrence of emergencies in China, more urgent requirements have been put forward for the improvement of emergency management system. As one of the important forms of emergency management, military-civilian joint action plays an important role in emergency rescue. However, in the past cases, there are still many problems in the process of local and military participation in emergency rescue, resulting in poor rescue effect. Command and Control (C2) model is a classical model in military command and control. It can analyze the military-civilian linkage system intuitively and systematically, and summarize the characteristics of each maturity level of C2 model to form a table. Based on this, the maturity of the military-civilian linkage accident rescue process is evaluated and the existing problems are analyzed, and the needle is put forward. The measures for sexual improvement and further optimization of the military-civilian linkage system provide experience support for the improvement of emergency management system in China.

1. Introduction

Since the 21st century, China has experienced many major public emergencies, for example: 5.12 Wenchuan earthquake, 9.18 Baicheng Coal Mine Storm and 7.23 Yongwen Railway Traffic Accident. The emergencies are unpredictable, in varied forms, uncertain and destructive, which have brought great loss of life and property to the public. In recent years, frequent emergencies have put forward more urgent and stricter requirements for the government's emergency management and rescue work, at the same time testing the ability of relevant government departments. The joint implementation of emergency rescue tasks in non-war military operations by the army has become a common practice in the world to enhance emergency rescue capabilities, and it is also an inevitable trend for the expansion of military missions in the era of peace. However, China's military-civilian interaction is still in its initial stage and cannot give full play to the advantages of local and military forces. With the help of the classical C2 model in the information age, the problems existing in military-civilian interaction are analyzed, which helps to identify the problems existing in military-civilian interaction, strengthen the cooperation between local and military forces, and thus promote the continuous improvement of emergency management system in China.

2. Basic Characteristics of C2 Model

2.1. Model Overview

Command and Control (C2) is the core concept of military command and control system. The C2 model can be used for effective research and analysis. C2 model is a three-dimensional spatial model, which takes information, interaction and decision-making as three basic dimensions. The model is shown in figure 1 [1]. The maturity of the model reflects the ability to influence, cope with or utilize



the changeable and urgent situation. That is to say, the higher the maturity of the model, the faster the response speed of the entity and the better the effect. For military-civilian interaction, that is, the maturity of information sharing between local and military forces, the timeliness of information exchange and the accuracy of negotiation decision-making.

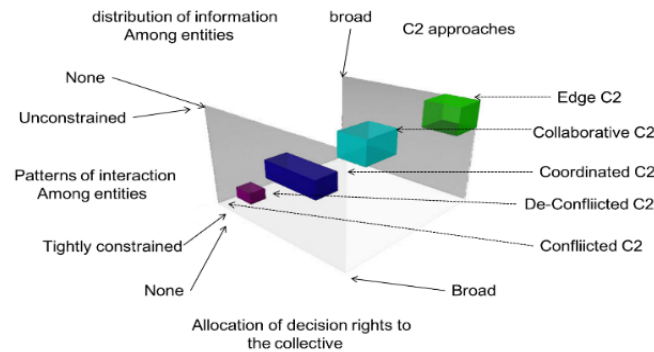


Figure1. C2 spatial model.

2.2. Maturity Analysis of C2 Model

C2 model maturity is divided into five levels [2]. Different levels of maturity correspond to different characteristics. Table 1 summarizes the characteristics of different levels.

Table 1. Different Level Characteristics of C2 Model.

	Information exchange	Command and decision	Formulate scheme	Cooperation	Real time interaction	System standard	Quantitative index	Flexible initiative	Quick reaction
Primary	Seldom	—	—	—	—	—	—	—	—
Secondary	Average	Finite	Imperfect	—	—	—	—	—	—
Tertiary	Strong	Nearly perfect	Perfect and reasonable	Preliminary realization	Finite	—	—	—	—
Quaternary	Perfect	Standard accuracy	Perfect and reasonable	Preferably	Nearly realization	Complete	Practical exercises	Initial appearance	—
Quinary	Mature	Precise command	Perfect and reasonable	Self-synchronization	Perfect	Complete	Accurate and reasonable	Nearly mature	Timely and accurate

When using C2 model to evaluate military-civilian interaction in emergency rescue process, there are often some subjective factors that interfere with the evaluation, resulting in incomplete and inaccurate evaluation, or inconsistent evaluation results and general evaluation effect. Summing up the characteristics of each maturity to form a table can not only unify the evaluation criteria, make the evaluation more objective, concrete and comprehensive, but also help to formulate targeted measures for the existing problems in the operation, so as to promote the military-civilian linkage system to play a further role.

3. The Role of C2 Model in Emergency Management System

Since the 21st century, unexpected incidents have occurred frequently all over the world. Governments are actively exploring the establishment of a military-civilian linkage system to deal with emergencies, constantly amending and improving in the process of exploration and practice, and establishing an emergency management system mechanism adapted to national conditions. Using C2 model to analyze the mechanism of military-civilian linkage system will help to improve the military-civilian linkage system and promote the maturity of the mechanism of emergency management system in China.

3.1. Significance of Military-Civil Interaction

3.1.1. Military-civilian linkage conforms to China's actual national conditions.

Countries around the world have established corresponding emergency management modes according to their own actual conditions: Canada established the Federal Civil Defense Organization in 1948, and established an independent local emergency preparedness Bureau in 1988; Russia established the Emergency Department directly under the responsibility of the President, with 400,000 emergency rescue troops under its jurisdiction as an independent police force, unified uniform and uniform police rank in accordance with the army system [4]. Considering the actual situation of China, it is unrealistic and unreasonable to assign emergency management work to private enterprise departments. If we set up a separate emergency management force, it will cause some redundancy. As an important part of the Party's governance of China, serving the people and ensuring the safety of people's lives and property are within the scope of its responsibilities. Therefore, it is necessary and reasonable for the army to participate in emergency rescue work.

3.1.2. Military-civilian linkage is conducive to the full utilization of resources.

Local have more information or technical resources in some areas, but lack of executors and operators; at the same time, the army has sufficient force, its firm execution and rapid mobility is incomparable to any local department, but if lacking the support of information technology resources, the action will often achieve twice the result with half the effort. Therefore, only when the troops and local governments unite to achieve complementary advantages in emergency management, make full use of their respective resources and give full play to their strengths, it will not only help the emergency management work to proceed smoothly and efficiently, but also help to realize the sense of belonging of the people and promote the development of military-civilian integration strategy.

3.1.3. Civil-military integration is the inevitable trend of the development of the times.

At the plenary meeting of the PLA delegation at the Third Session of the Twelfth National People's Congress on March 12, 2015, Comrade Xi Jinping clearly put forward the idea of "upgrading the development of civil-military integration into a national strategy" [5]. The so-called military-civilian integration refers to the integration of national defense and army modernization into the economic and social development system, providing resources and impetus for the realization of national defense and army modernization, realizing the parallel development, and ensuring the unification of the Chinese dream and the dream of strengthening the army in the process of building a well-off society in an all-round way in China. In addition, many countries, such as the United States, Japan, Russia and the European Union, have also taken different ways to promote their civil-military integration. As a typical example of civil-military integration, the defense science and technology industry system established by the United States saves about US\$30 billion annually for the US Department of Defense, which is about 20% or more of its total acquisition costs. It can be seen that civil-military integration is an inevitable trend in the development of the world. As an important part of civil-military integration, military-civilian joint action is conducive to better sharing of resources and technology between the army and society, mutual promotion and common development, and promoting the maturity of emergency management system.

3.2. The Role of C2 Model in Military-Civil Interaction

As an important means of emergency rescue, military-civilian joint action has been recognized and used by more and more countries and is becoming more and more perfect. However, emergency management in China is still in its infancy, and its contents are not mature and perfect. The maturity and perfection of military-civilian interaction needs the support of powerful information network: the emergency command platform established in Australia, which unifies and efficiently manages all kinds of information; Japan has a perfect emergency information infrastructure, efficient and strict disaster prevention communication network to achieve national coverage; Russia's crisis control center collates and analyses information from all parts of the country and merges them, and gives feedback. However, the information platform of China is not mature and the system is not perfect. There are still some

problems in the process of military-civilian interaction, such as information sharing, exchange and consultation, decision-making and implementation.

C2 model makes a specific qualitative analysis of information, interaction and decision-making, and divides the emergency rescue faults of military-civilian linkage into three categories: a) communication faults, whether the communication is smooth or not is largely related to the network platform supporting the mission, and also to the environment of the mission area; b) interaction/sharing faults, and the letters of each unit participating in rescue in the rescue process. Interaction and sharing of information is the basis for the successful completion of rescue tasks. Only through adequate communication between local and military forces in the process of rescue, can local and military forces fully play their roles and form the greatest synergy; c) decision-making failure, correct decision-making is the prerequisite for the successful completion of tasks, and only by making proper decisions, can the rescue effect be optimal.

C2 model can systematically analyze military-civilian interaction, formulate corresponding measures more efficiently and pertinently, optimize the mechanism of military-civilian interaction system, accumulate practical experience, and promote the further development of military-civilian interaction.

4. Case Evaluation and Analysis Based on C2 Model

The typical cases - 5.12 Wenchuan Earthquake and 8.12 Explosion Accident in Tianjin Binhai New Area - are evaluated and analyzed by Table 1, and the maturity evaluation is carried out. Based on the information in the table and the evaluation results, several pertinent improvement measures are put forward, which will help to further accumulate rescue experience and optimize the rescue system.

4.1. Typical Case Analysis

4.1.1. Case 1 5.12 Wenchuan Earthquake.

5.12 Wenchuan Earthquake occurred on May 12, 2008, Beijing time. It was the most destructive earthquake since the founding of the People's Republic of China, and also the most casualty earthquake after the Tangshan Earthquake. After the earthquake, social organizations, earthquake rescue forces, armed forces of the Chinese People's Liberation Army and other forces immediately put into rescue. Under the leadership of the Central Committee and the State Council, Comrade Wen Jiabao set up a headquarters for the commander to carry out rescue work. However, due to bad weather conditions, interruption of communications, insufficient experience preparation and imperfect emergency rescue system, rescue work cannot be unfolding smoothly.

Next, the C2 model is used to evaluate the military-civilian joint rescue work in Wenchuan Earthquake and to evaluate its maturity.

a) Information exchange: After the earthquake, the road, power and communication in the disaster area are interrupted. Because of the bad weather, as well as the inadequate infrastructure and safeguards, it is impossible to obtain information about the internal situation in the disaster area. The information exchange between the various elements involved in rescue is insufficient, and even the phenomenon of blocking each other's information appears, which is assessed as seldom.

b) Command and Decision-making: Seismological Bureau responded to the earthquake, but because of its insufficient influence, it was difficult to carry out its work smoothly in coordination and command. Subsequently, the Central Committee of the Party and the State Council unified command and coordination, and Comrade Wen Jiabao served as commander, and established a unified command headquarters. However, the mechanism of command and transfer at lower levels is not perfect. There are many problems in command among local, army and even departments, such as too many command levels, multi-head command, and lack of necessary information support, which makes it impossible to make rapid and accurate decisions, which is assessed as poor.

c) Programming: The local government has formulated relevant disaster preparedness plans before, but the pertinence and practicability of the preparedness plans are poor, and there are still serious similarities. Emergency plans are not practical, lack of on-site situation, lack of experience, unable to quickly and accurately formulate the action plan, and lack of corresponding exercises in the early stage,

resulting in confusion in local and military operations in the early stage of rescue, lack of follow-up to the corresponding plan, which is assess as bad.

d) Cooperation: The coordination mechanism of military-civilian interaction in Wenchuan Earthquake was not perfect, which led to different departments' inconsistent response, and thus could not cooperate. On the other hand, the local and military departments and departments had not formed the consciousness of military-civilian interaction, and there was no awareness of information sharing and exchange, and some even blocked each other's information and did not support each other, which is assess as bad.

The rest are not reflected.

Table 2. Assessment of Military-Civil Interaction in Emergency Rescue of 5.12 Wenchuan Earthquake.

	Information exchange	Command and decision	Formulate scheme	Cooperation	Real time interaction	System standard	Quantitative index	Flexible initiative	Quick reaction
Assessment	Seldom	Poor	Bad	Bad	—	—	—	—	—

Its maturity level is assessed as primary.

4.1.2. Case 2 8.12 Explosion accident in Tianjin Binhai New Area.

On August 12, 2015, a fire and explosion accident occurred in the dangerous chemical warehouse of Zhuhai Company, located in Tianjin Port, Tianjin Binhai New Area, which caused serious loss of personnel and property. It was a particularly serious accident of production safety responsibility. After receiving the news of the fire, the fire brigade of Tianjin Port Public Security Bureau arrived at the scene as early as possible. About forty minutes after arrival, the first explosion occurred, followed by the second explosion. After the accident, fire forces, police, government, local government and PLA and other departments participated in emergency rescue operations, coordinated and cooperated in many ways, and used advanced technology such as UAV to understand the situation on the scene, and carried out more reasonable and efficient emergency rescue work on the basis of military-civilian interaction.

Next, the C2 model is used to evaluate the military-civilian joint rescue work in the explosion accident of Tianjin Binhai New Area and evaluate its maturity.

a) Information Exchange: After the accident, Beijing Fire Department downgraded two UAVs to meet the requirements of the Fire Department of the Ministry of Public Security, and drew a 360-degree panorama of the accident scene using UAVs, which provided basic information support for the emergency rescue work. Although the accident led to traffic jams and confusion, AVIC's company used helicopters to carry out aerial survey of the scene, real-time transmission of the explosion scene, and detailed survey of the potential fire points, providing real-time and reliable information for emergency rescue command and decision-making, and assessment for average.

b) Command and Decision-making: About an hour after the accident, the accident investigation team announced the establishment of the general command headquarters. Huang Xingguo, then acting secretary of the Tianjin Municipal Party Committee, served as the general commander, and five working groups under its jurisdiction carried out their work in an all-round way. The CPC Central Committee and the State Council Working Group also rushed to the scene of the accident to coordinate and guide emergency rescue work. More than 120 local and military units participated in the emergency rescue work. There were 20 command agencies of various types, and the scene was complex. However, the command subject and command relationship were relatively clear, which ensured that the rescue and rescue work was carried out reasonably and orderly, and the evaluation was finite.

c) Planning: In the early stage of rescue, the information about the quantity, content and storage mode of dangerous chemicals in factories is not clear, and it is impossible to formulate effective rescue plans. However, in the process of emergency rescue, the local and military pay attention to communication, and invite experts from all walks of life to investigate the situation on the spot, and carry out repeated experimental verification. The formulation of the plan is more scientific and reasonable, and the evaluation is average.

d) Collaboration: Emergency rescue forces cooperate with the military and the civilian forces. A total of 16,000 people, including the army, police and the public, take part in the rescue work. According to their own characteristics, the PLA biochemical emergency rescue team and the Hebei Fire and Chemical Corps, as well as the Liaoning and Jiangsu Biochemical Reconnaissance Corps, jointly carry out rescue work. In the rescue process, the military-civilian coordination is good, but there is still a lack of communication between each other, and there is no effective communication between each other. Cooperative work depends on the unified command and dispatch of superiors, which results in a certain degree of constraints and poor evaluation.

The rest are not reflected.

Table 3. Assessment of Joint Military-Civil Action in Emergency Assistance to 8.12 Explosion Accidents in Tianjin Binhai New Area.

	Information exchange	Command and decision	Formulate scheme	Cooperation	Real time interaction	System standard	Quantitative index	Flexible initiative	Quick reaction
Assessment	Average	Finite	Average	Poor	—	—	—	—	—

Comprehensive evaluation of its maturity level is secondary.

4.2. Suggestions on Improving the Rescue Effectiveness of Military-Civil Interaction

Through case 1 and 2, we can see that there are still many problems in the behavior mode of military-civilian interaction in the process of emergency rescue, and insufficient information exchange between local and military forces is the key to the problem. Nowadays, the world is in the era of big data, and the rational use of effective information is the key to win. But in the case of 5.12 Wenchuan Earthquake and 8.12 Tianjin Binhai New Area, there is not only no basic information support, but also great limitation of real-time information interaction and sharing between local and military forces, which leads to poor cooperative operation effect. In view of the problems found in the analysis of two cases by C2 model, the following improvement measures are put forward:

a) Establish a comprehensive emergency information support platform system. Timely and accurate information is the basis of a mature emergency management system. When an emergency occurs, it is necessary to ensure that the accident information is transmitted to the command center at the first time, and the command center responds quickly. After making a decision, the decision-making and deployment are sent to all the elements participating in the operation quickly, and the real-time interactive sharing of information resources is realized. The elements involved in emergency rescue update the situation of the scene in real time, feedback the information of the scene processing, respond quickly according to the command post's adjustment order, and complete the task more accurately and efficiently. In peacetime, the national emergency management network is monitored dynamically in full time, data information is updated and analyzed in real time, emergency events are predicted, and the information network is maintained daily, so as to maintain the absolute security of the information network and to ensure timely and accurate transmission of information when necessary.

b) Improve the legal system of emergency management. The law is the guarantee for the smooth development of emergency management. The relevant laws and regulations in our country are not perfect. Only some pertinent laws and regulations have been promulgated, and there is no comprehensive emergency management laws and regulations. As a result, emergency management work can only rely on past experience or refer to other laws and regulations. The lack of comprehensive laws and regulations leads to the ambiguity of command and cooperation among regions and elements, and to a certain extent leads to the separation of forces, government departments and social organizations, which cannot play a good role in emergency rescue. Emergency management laws and regulations should clearly stipulate the emergency management system, social responsibility, command relationship and specific rules for the implementation of tasks, so as to make all emergency management work legally and regularly.

c) Strengthen emergency drills. Regularly organize and exercises, strengthen joint military-civilian emergency command training exercises with consistent combat training [9], and draw lessons from the

exercises. The drill should be standardized and standardized, covering the whole process of prediction, incident, in-process and after-event. Commanders should fully grasp the situation on the spot, refer to the party's plan database [10], expert database, and quickly formulate plans in accordance with the actual situation on the spot, coordinate all elements of emergency rescue, and ensure the rational distribution and full utilization of relief materials. At the same time, experts will be convened to discuss and optimize the rescue plan and adjust the command order in time according to the feedback of all elements involved in the rescue. According to the command order, the elements of emergency rescue quickly arrive at the designated location to launch operations, feedback the situation of the scene in real time, update the accident dynamics in time, and communicate with each other among the elements to realize information and resource sharing. In addition, it evaluates the command, response, scheme and effect, updates the optimization scheme database and expert database in time, and provides a more reliable basis for the formulation and implementation of the later scheme.

5. Conclusion

Based on the characteristics of C2 model, this paper analyses the different characteristics of each maturity of the model, uses the model to analyze the situation of military-civilian linkage rescue in the 5.12 Wenchuan earthquake and 8.12 Tianjin Binhai New Area explosion accidents, points out the problems existing in military-civilian linkage in the process of emergency handling, and puts forward corresponding improvement measures. C2 model can be widely used in the evaluation system of military-civilian linkage emergency rescue, more systematic and comprehensive analysis of problems and targeted solutions, providing valuable experience for military-civilian linkage to play a better role in emergency management.

As the necessity of emergency rescue development, military-civilian joint action is of great significance to the improvement of emergency management system. However, due to the large number of departments involved in military-civilian interaction [11], there is no effective institutional mechanism for the joint command and information sharing between the army and the local authorities, which has resulted in many restrictions on the development of joint military-civilian Emergency Force [12,13]. Therefore, we should draw lessons from practice over and over again, constantly optimize and improve the military-civilian linkage system, explore a set of system mechanism suitable for the actual situation of our country, and provide strong support for the development of emergency management in our country.

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