

# A Summary of the Application and Research of the Command and Control Organization Theory in Emergency Communication Support

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**Abstract**—In recent years, the emergency communication support has been fully developed. With the progress of the times, the problems of the emergency communication support are constantly changing, and new methods are needed to solve the problems. This paper summarizes the current researches on the problems in the emergency communication support of the armed police force solved by using the command and control organization theory. The analysis and discussion of the researches are carried out, and the existing problems are pointed out. The application and research of the command and control organization theory on the emergency communication support is prospected.

**Keywords**—command and control organization theory; emergency communication support; application and research

## I. INTRODUCTION

General emergency communication in China can rely on public communication network to implement security. However, original communication resource and communication method can not play a role in the snow storms, freezing disaster, earthquake, debris flow and other a series of sudden natural disasters and the Olympic Games, the Asian Games, World Expo and other major public events, we need to take unconventional means to carry out emergency communication support.

Emergency communication is an important communication activity which depends on the public network in a special case, integrated utilization of various communication resources and technical means to ensure the safety of smooth communication. It is to ensure that in case of emergency, personnel can use the remaining or temporary arrangement of the communication resources to establish a communication link, to ensure the smooth communication.

It is necessary to improve and perfect the emergency communication support in China. And the following will list some of the typical problems:

1) The existing emergency communications system can not be effectively scheduling and command

The function of each department and system is single, and they are of mutual independence. When major emergencies occur, they are unable to timely and effectively cooperate and

exchange, thereby affecting the implementation of emergency communication support.

2) Emergency communications support force is not perfect

Personnel of emergency communication unit which is temporarily build have single business skill, and they cannot fit the requirements of communication support in the rescue. The supply and distribution of emergency communication resources is not scientific.

3) The subjective color is strong when the commander makes the command decision

The commander makes the command decision to carry out emergency communication support according to the personal experience and subjective judgment, while he does not grasp the actual situation of the incident site. It is easy to cause 'the second decision', and wastes time.

The above problems are the blind area of the organizational structure of emergency communication support, and these problems can be solved by using the command and control organization theory.

The literature [1] defined the command and control organization as: under the action of the combat mission, the operational resource entities in the battlefield environment will form the overall orderly behavior and the coordinate relationship of the command and control structure. The command and control organization contains many operational resources, and relations of command and control between them. It also contains the environment related to the organization.

In order to solve these problems, the command and control organization theory adopt the idea of mathematical optimization to optimize organizational structure and reasonably distribute forces and resources, so as to improve organizational effectiveness. As an organizational form, it is similar to the traditional organization and also has its unique characteristics. It is mainly through the study of battlefield environment and the organization state of the enemy forces, to improve the survival ability of combat troops on the battlefield. The command and control organization theory is applied to the emergency communication support, by means of optimizing the allocation of resources, adjusting the organizational structure and reasonable planning task to build a better

organizational structure, so as to solve the problem of command and control in emergency communication support. It can better implement emergency communication support and have a good application prospect.

## II. THE APPLICATION STATUS OF THE COMMAND AND CONTROL ORGANIZATION THEORY IN THE EMERGENCY COMMUNICATION SUPPORT

At present, Armed Police Forces began to refer to the command and control organization field, mainly is to apply the command and control organization theory to emergency communication support for application research, and has obtained some achievements: Shao Wenjing published a master thesis "Research on the Application of the Command and Control Organization Theory in Communication Support in Earthquake Relief Work of CAPF" [2] in 2014, Fu Jie published "The Application Of Three Stage Command and Control Organization Design Method in Emergency Communication Support"[3] in May 2015. In October 2015, Chen Shuai published "Exploring spatial structure of effectiveness measure for communication support organization"[4] and "The Design Method Of Earthquake Relief Communication Support Organization Structure"[5], Fu Jie published a master thesis "Research Of Emergency Communication Support Based on Adaptability Command and Control Organization Theory "[6].Chen Shuai published a master thesis "Research on the Application of the Measure of C2 Organizational Effectiveness Theory in Communication Support in Seismic Relief Work"[7]. The above research contents can be summarized as 3 aspects:

### A. *The Application Research of Command and Control Organization Theory in the Construction of Emergency Communication Support Organization*

Shao Wenjing [2] took the command and control organization theory into the field of earthquake relief communication support, and proposed emergency communication support organization structure and design methods, creatively adapting the idea of mathematical optimization to design organizational structure and effectively improving problems of the original communication support organization structure unreasonable and uneven distribution of resources. She focuses on three stage design method , and applies it to the case of 5·12 Wenchuan earthquake relief communication support, verifying the feasibility and effectiveness of the command and control organization theory in emergency communication support by analysis and demonstration.

Fu Jie's early work was around the construction of emergency communication support organization, and proposed two design methods of command and control organization: three stage command and control organization design method and based on granular computing command and control organization design method [8]. In the literature [3], she mainly discusses the application of three stage command and control organization design method in emergency communication support, and verifies the rationality and effectiveness of the method by a case of earthquake relief communication support.

### B. *The Application Research of Adaptive Command and Control Organization Theory in Emergency Communication Support*

Considering the characteristics of adaptive command and control organization, Fu Jie [6] proposed to be used in the emergency communication support, optimize the organization design. In the article, Fu Jie combined with the theory of command and control organization theory, proposed the two kinds of command and control organization design method and three kinds of organizational adaptation adjustment method and applied it to emergency communication support, organized the design, selected the relevant evaluation index to the quantify the effect of design. Combined with the specific case of emergency communication security of the armed police force, the model is established, and the organization adaptability design is carried out by using three kinds of adaptive methods. The specific thread of this paper is: firstly, organization structure was established with the command and control organization theory; then, according to the changes of the mission environment, select the appropriate organizational adaptability adjustment method. Finally, combined with the corresponding evaluation index, the application effect of the three methods is analyzed and evaluated, and demonstrate the feasibility of the adaptive command and control organization theory in the emergency communication support.

### C. *The Application of Command and Control Organization Effectiveness Measurement Theory in the Earthquake Relief and Disaster Relief Communication Support*

If the influence of complex seismic environment and various uncertain factors brought to the communication organization support lack of quantitative analysis, it may lead to the failure of earthquake relief mission. In order to solve this problem, Chen Shuai [7] in the study of emergency communications support to introduce the theory of organizational effectiveness measure.

In the existing 4 methods of efficiency measurement, exploratory analysis method is widely used because of its unique advantages. In order to implement the communication support of earthquake disaster relief more effectively, Chen Shuai has made a deep research on the problem of exploring space in the literature [4]. In using the command and control organization theory to guide earthquake relief emergency communication support tasks, combined with the actual situation, using exploratory analysis method to establish model, model building, to quantify the influence factors of communication support organization effectiveness in the dynamic environment from traditional qualitative analysis to quantitative analysis. According to the following two points of thought to start work: on the one hand, study on how to measure the pros and cons of communication support organization effectiveness; on the other hand, in the dynamic environment, study on the influence of various uncertain influence factors on the communication support organization.

The research results of the above 3 directions verify that the theory of command and control organization can be applied to solve the problem of the organization structure. The application research of the command and control organization theory in the emergency communication support is also called the research

of the emergency communication support organization. There are some deficiencies in the research results:

Shao Wenjing's research is based on the assumption that the earthquake relief is communication support task environment is static environment, and the organization structure is designed. The environmental parameters were set up in advance, and the changing factors were not considered. Therefore in carry out the process of communications support task, the design of organization structure can not meet the requirements of tasks, resulting in the task can not be completed on time. In addition, the priorities of communication support, task and the needs of communication equipment in the different regions is not to be clear, only set the same parameter values to calculate. As a result, it is difficult to apply the theory innovation of the communication support organization structure design based on the three stage method in practice.

Fu jie combined with the theory of adaptive command and control organization, choose the method of adjust the organization structure to solve the problem of the communication support organization to face the complex dynamic environment. Therefore, in the research of FuJie and others, the organization structure of some spare parts need to be designed in advance. In the process to carry out the task, according to changes in the mission environment and other factors caused by variations in task demand to select the best match organization structure. It caused the waste of the resources of the remaining organization structure. According to the theory of Taguchi[9], the system is less sensitive to the dynamic environment than the control system to adapt to the dynamic environment.

Chen Shuai and others research on the communication support of the armed police force by using the theory of command and control organization effectiveness measurement seize the key factors from various uncertain factors in the rescue operation, to quantify and quantitative analysis. However, in the research of the exploratory analysis of the experimental stage, the design of the organization structure is based on the three stage method. The method is not very ideal, and it is more sensitive to the change of parameters in dynamic environment, which affects the final result. So the follow-up should adapt other organization structure design method to carry on the design to the emergency communication support organization. In addition, the effectiveness of the measurement mechanism remains to be improved, especially the indicators need to be further refined.

### III. THE RESEARCH DIRECTION OF EMERGENCY COMMUNICATION SUPPORT ORGANIZATION

The research of command and control organization theory in the emergency communication support of the armed police force provides a creative idea for the armed police force to improve the emergency communication support system, broaden the application prospect of armed police force of emergency communication support and can be from the following several aspects to carry out in-depth studies.

#### A. *The Process Design Research of Emergency Communication Support Organization*

Organization design includes two parts of process design and structure design, the process design is the foundation of structural design, structural design is the pursuit of the best process design, the two complement each other. Applying the theory of command and control organization to study the organization of emergency communication guarantee, It is not only to study the organization structure design, but also can make a further research on it from the organization structure design. It is necessary to study the organization process design to make adjustments, to pursue the organization process and the structure of the optimal match when the organization structure design can not meet the needs of completion of the emergency communication support task.

To study the process design of emergency communication guarantee organization by using the theory of command and control organization theory, which is essentially the plan for communication security. In short, choosing the best communication security solutions and complete the emergency communication security task by using the limited communication resources. Specific can be taken as follows: according to the communication resources, time on task and other factors, combined with the resource requirements of communication security objectives, to optimize the allocation of platform resources, resulting in the process of action [11].

#### B. *The Research on Automatic Decision Support System of Emergency Communication Guarantee Organization*

The implementation of emergency communication support at this stage, mainly rely on the situation of human judgment, the dispatch of communication power, to complete the task of communication security. This may cause the low utilization communication resources, so it is necessary to try to establish a computer automation system, enter task information according to the field situation, the system will generate communication support scheme automatically and deploy of communication power reasonably. In the next research, the paper focuses on how to establish the case of emergency communication support, the the basic database and knowledge base of the corresponding plan and the realization of automatic configuration software, etc.. Based on the information of emergency communication support in the past years, provide the basic data for the automated decision support system. The knowledge base mainly absorbs the decision knowledge of communication commanders at all levels, and provides decision knowledge reserves for automated decision support system. Automatic configuration software can consider the relevant theory and algorithm of Wen Jing Shao, Fu Jie, Chen Shuai and others, and according to the need to improve the process design, robust design and other related content, to provide software support for the automated design support system.

#### C. *The Research on the Modeling and Simulation Technology of Command and Control Organization*

Applying the theory of command and control organization theory to study the emergency communication guarantee, in order to describe the situation directly and objectively, it is needed to establish a good model in the analysis of specific

cases. The modeling and simulation technology of charge organization has become a hot research topic.

There are five kinds of modeling methods: computational and mathematical organization theory, Petri net, information theory method, agent and social network analysis method; and the simulation experiments mainly has two kinds of a2c2 experiments and the concept of command and control organization test bed [12]. In the next step of research, we can combine the command and control organization to analyze the emergency communication security task. The static organization model is transformed into an organization model which can adapt to the dynamic change of environment. Combined with the specific case of emergency communications security to analysis the scientific and effectiveness of the establishment of the organization model.

#### D. The Research on the Robustness of Emergency Communication Support Organization

Fu Jie etc. Study by adjusting the organizational structure to adapt to environmental changes. However, according to the theory of Taguchi [9], the system is less sensitive to the dynamic environment than the control system to adapt to the dynamic environment, the cost of the dynamic environment is small. Therefore, in the case of emergency communication security, for a variety of emergencies caused by the dynamic, uncertain mission environment, you can consider the establishment of a robust organizational structure. A robust emergency communication guarantee organization, which can realize the non sensitivity to the external environment by the redundancy of the task resources. Therefore, in the face of dynamic changing environment, it is not needed to change its organizational structure can still maintain a good performance. The next step is to focus on how to design a robust emergency communications support organization structure that can complete a certain range of communication security tasks.

#### IV. CONCLUDING REMARKS

In this paper, the theory of command and control organization and emergency communication security are described, the three application research results of command and control organization theory in the emergency communication security of the armed police force are summarized, and the three research results were analyzed and discussed, and found the deficiencies: The organizational structure based on the three stage method is too sensitive to the dynamic environment, which affects the result of the experiment; the use of adaptive methods of organization adaptability design will result in a waste of resources. Finally, the paper focuses on the detailed description of several directions of emergency communication security by using the theory of command and control organization, and the prospects for its development: command and control organization theory has changed the traditional experience command mode, digital, systematic analysis of communication capacity and communication resource requirements, to build an organization structure more scientific and its application helps to enhance the performance of emergency communications support command, to complete various tasks with high quality. This review has great reference significance and reference value for

the further research of emergency communication security of the armed police force.

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