



# Research on Modular Flow Method of Emergency Response Training Organization

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**Abstract.** Emergency response training are an important means to test the rationality of emergency plans, improve emergency response mechanisms, and enhance emergency rescue capabilities, etc. In view of the current problems of poor departmental coordination, formalized organizational process, and emphasis on performance rather than practice in practical exercises, this paper proposes an emergency response training organization method based on modularized process, from time planning, scene setting, command system, unit coordination, linkage response, disposal measures, etc. The paper clarifies the design process of emergency response training from six elements, such as time planning, scene setting, command system, unit coordination, linkage response and disposal measures, and improves the scientific, practical and operability of emergency response training design and organization through theoretical analysis and example demonstration of the modularization of emergency response training process. The research results can provide reference for the government, parks and related enterprises and institutions to carry out emergency response training design and organization.

**Keywords:** Emergency drill organization · Emergency response plan · Command system

## 1 Introduction

At present, enterprises regularly organize various forms and types of emergency drills to fully exercise the coordination and organization and emergency disposal capabilities of personnel at all levels in response to unexpected accidents. In September 2019, the Measures for the Management of Production Safety Accident Emergency Plans were implemented to standardize the management of production safety accident emergency plans, to deal with production safety accidents quickly and effectively, and to provide guidance on emergency drills based on various laws and regulations [1]. Emergency drill organization as an important work of emergency preparedness is an effective test of the plan and the effect of training, which is of great significance to improve the operability and relevance of the emergency plan, the emergency disposal ability of enterprises and and communication and coordination ability, and is an indispensable part of the continuous improvement of the emergency plan and the improvement of emergency response

capability [2]. In recent years, in response to some emergencies that have occurred in China, governments and business units at all levels have made certain improvements in the requirements for emergency drills, and governments and business units at all levels have begun to proactively organize emergency drills to improve the ability of all levels of society to respond to various emergencies. For the problems to be solved in the process of organizing emergency drills, this paper discusses and proposes an emergency drill organization method based on a modular process by summarizing various problems that occur in emergency drills.

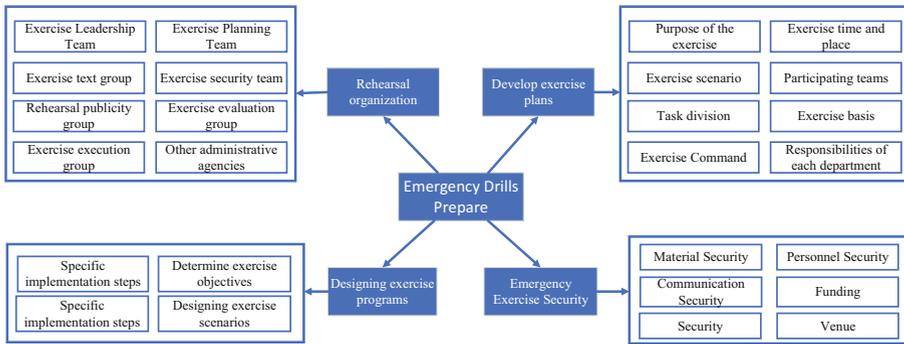
## 2 Classification and Requirements of Emergency Drills

The classification of emergency exercises is to better organize and implement exercise activities according to exercise objectives. Emergency drills can be divided into desktop drills [3] and live drills according to the organizational form, single drills and comprehensive drills according to the content, and test drills, demonstration drills and research drills according to the purpose. Different types of emergency drills have different scopes of application, e.g., desktop drills are more suitable for clarifying the division of responsibilities of emergency organizations and emergency response processes, while live drills are more suitable for testing the response capability and speed of emergency teams [4]. There are various forms of emergency drills, which can be selected according to the needs of the enterprise. However, the most appropriate drill should be selected according to the purpose of the drill, so as to achieve the best drill effect.

In terms of the frequency and content of emergency drills, there are clear requirements in the existing laws and regulations, departmental rules and government plans. The organizers of emergency drills need to make emergency drill plans according to the actual situation, based on relevant laws and regulations and the higher emergency plans of the government, industry or department. For example, the Measures for the Management of Production Safety Accident Emergency Plan stipulates that production and operation units should organize at least one comprehensive emergency plan drill or special emergency plan drill every year, and at least one on-site disposal plan drill every six months. For some special industries, such as flammable and explosive substances, hazardous chemicals and other dangerous goods production, operation, storage, transport units, mining, metal smelting, urban rail transit operations, construction units, etc., should be organized at least once every six months production safety accident emergency rescue plan exercises.

## 3 Emergency Drill Organization

Before the emergency drill is organized, it is first necessary to make preparations for planning, mainly including the establishment of the emergency drill organization, the development of the drill plan, the design of the drill program, the determination of the emergency drill security and other aspects, which generally need to be determined, as shown in Fig. 1.



**Fig. 1.** Emergency drill organization

- (1) Organizational structure of the emergency drill. It is usually set up according to the nature of the emergency drill simulation scenario, including the emergency drill leadership team, the drill planning team, the drill copywriting team, the drill publicity team, the drill security team, the drill evaluation team, and other administrative agencies of the enterprise [5].
- (2) Formulate the drill plan. The drill plan needs to clarify the basis and purpose of the emergency drill, the time and place of the drill, the organization and responsibilities of the drill and the division of tasks, the drill subjects and the guarantee of the drill. The emergency drill plan can be prepared with reference to emergency management norms and standards.
- (3) Designing the drill plan. The design of the exercise program first needs to determine the objectives of the exercise, that is, by whom under what conditions, based on what criteria, to complete what tasks, to achieve what effect. Second, it is necessary to design the exercise scenario and implementation steps. An outline description of each exercise scenario is provided, indicating the type of event, time and place, intensity and danger, scope of impact, distribution of personnel and materials, and other environmental conditions such as meteorology. Prepare an emergency drill script according to the relevant plan, describing the drill event scenario, disposal actions, executing personnel, instructions and dialogues, video background and subtitles, and ending times. Finally, the exercise plan needs to be evaluated by the expert group to ensure that the plan is scientific and feasible.
- (4) Emergency Exercise Security. Exercise security is a necessary condition to ensure that the exercise can be carried out smoothly, mainly to determine the materials, communications, venues, personnel and funds required for the exercise, and at the same time, the exercise site also needs to set up corresponding security measures to ensure that the exercise is carried out safely.

#### 4 Problems in the Organization of Emergency Drills

In the actual organization of emergency drills, although the process of emergency drills can basically meet the relevant requirements, the following problems often tend to occur in the time arrangement, command system and disposal practice.

#### **4.1 Time Sequence Arrangement is Complicated and Confusing**

The rational arrangement of the time sequence is crucial to the smooth running of the exercise activities. If the exercise is to be carried out in an orderly manner, it is necessary to determine the main line of time first. In the actual operation process, there are two main problems that can easily arise: (1) the node time of each link is unknown causing confusion in the articulation. The important links of the exercise are not precisely connected, which will affect the expected effect of the whole emergency exercise program. (2) action link time design is not reasonable. Many action links exist in the phenomenon of heavy performance and light practice, simplifying the action content and compressing the action time, thus leading to the design time can not complete the prescribed action, the participants do not feel strong sense of site. Therefore, without a reasonable and orderly time sequence arrangement, the emergency drill and the actual disposal action will be disconnected, thus making the drill unable to achieve the role of testing the reasonableness and operability of the plan.

#### **4.2 Cross-Departmental Chain of Command Responsibilities are Unclear**

Whether in preplanned exercises or in the actual disposal process, the rapid formation and efficient operation of the command authority is the key to ensure the final effect. In the process of emergency drill organization, the process of establishing command authority is often neglected and commanders are directly formulated without the necessary clear procedures of command authority. In particular, in the emergency rescue process of comprehensive accidents, which usually involves multiple linked units, such as including firefighting, medical, public security, and environmental protection, the coordination process of the on-site command system is easily ignored in the drill organization in the face of different ministry task demands [6, 7]. Although the majority of the emergency drill process will have the establishment of the on-site command department, but for the specific command chief is set to change the lack of clear reference standards or operational mechanisms.

The lack of a clear command system will lead to a lack of information communication and cooperation between departments, and will also affect the deployment of emergency supplies between departments [8], thus affecting the expected effect of the whole exercise program.

#### **4.3 Field Disposal Actions are Not Standardized**

In the process of emergency drills, the root cause of the widespread phenomenon of emphasizing performance over practice is the lack of requirements for the detailed design of emergency drills. Whether it is a general plan or a special plan, the authenticity of the drill is mainly reflected in the requirements for specific actions, which must be focused on in the organizational design of the drill. Generally speaking, the detailed actions of the overall plan come from the special plan connected with it, and the detailed actions of the special plan come from the on-site disposal plan connected with it, especially for the comprehensive exercise may involve the contents of multiple special plans or on-site disposal plans. If the site disposal program is too rough or can not be specifically reflected

in the exercise involved, then it will lead to the site disposal action is not standardized, action time is not reasonable and so on.

To sum up, any exercise plan should be guided by the core framework to strengthen the detailed construction of each element. Therefore, this paper tries to establish a modular construction method of emergency drill process to solve the existing problems.

## 5 Modular Design of Emergency Drill Process

### 5.1 Emergency Drill Process Module

According to the public safety triangle theory proposed by Fan Weicheng et al. [9], as shown in Fig. 2, the six elements of time planning, scenario setting, command system, unit coordination, linkage response, and disposal measures were established to clarify the emergency drill design process.

As shown in Fig. 3, these six elements are reflected in the design of the six elements with response level as the core, specifically time, scenario link, collaborative unit, command system, incident unit and disposal plan. Among them, time, command system, and disposal plan belong to the process and mechanism class without physical preparation, while scene link, collaborative unit, and incident unit belong to the personnel and resource class physical preparation.

Through the modularization of the emergency exercise process, the relationship between each element can be clearly defined. In the preparation of the emergency drill program, the initial conditions of the accident should be determined according to the accident scenario, i.e. the time when the drill occurs, the disposal plan, the accident level and the command system, and the emergency drill process should be clearly defined, and the scenarios of each link should be clearly defined, while the corresponding emergency disposal measures should be made according to their levels.

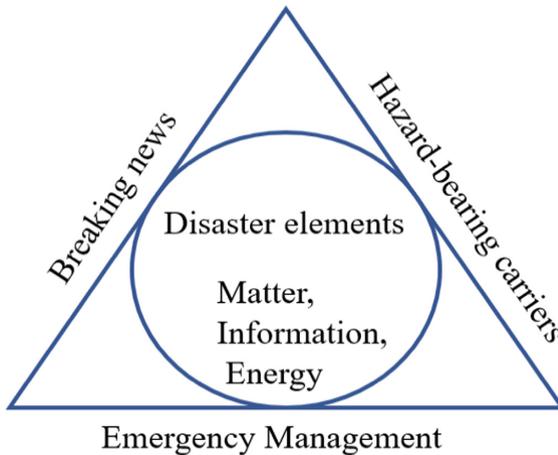
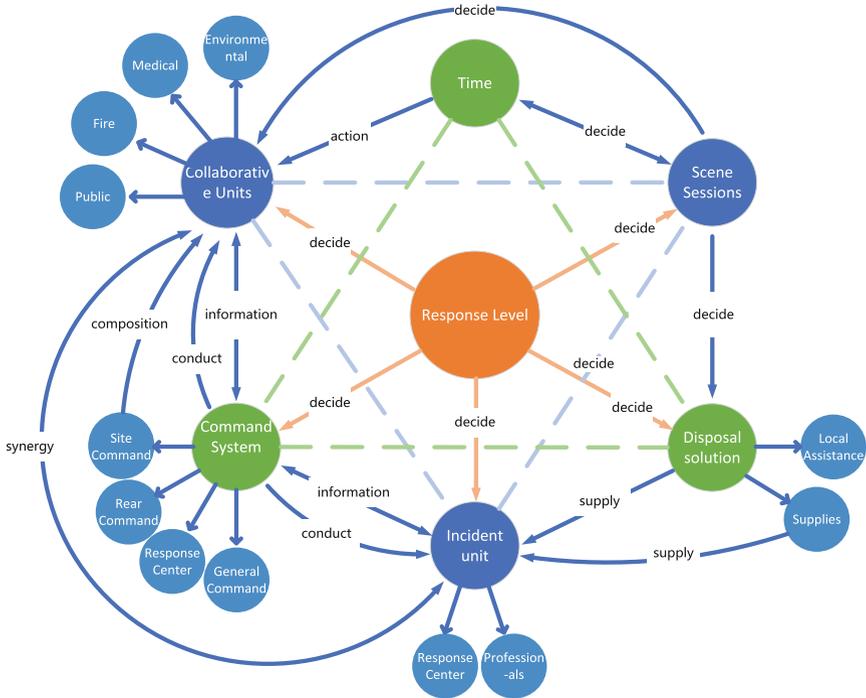


Fig. 2. Public safety triangle



**Fig. 3.** Emergency Exercise Flowing Module

Central to the design of these six elements is the determination of the response level of the incident. The difference in response level determines the changes in the collaborative units, command system and disposal plan in the exercise. Especially in the process of accident disposal, if the response escalation occurs, the difference in the scale of the exercise before and after the response escalation should also be considered. In the exercise design, the operational mechanism of the command system and the formation and normal operation of the on-site command are the key aspects to be examined. The unit to which the on-site command authority belongs is generally determined by the exercise theme. With the escalation of response, it may be necessary to set up on-site command and rear command, and the on-site command command collaborates with units to form different working groups and cooperate to complete various emergency disposal work under the unified command of the rear command.

**5.2 Modular Function for Emergency Drill Process**

(1) Clear time sequence and precise control of the exercise process

By setting the world time, sequence time and action time to achieve precise control of the exercise process. As shown in Fig. 4, each emergency link is clearly regulated through the time module. The world time is the external real time of the emergency drill organization, the sequence time is timed from the beginning of the

Time Series			
World Time	Sequence time		Action time
Enterprise response level		Campus response level	
Enterprise emergency disposal		Park emergency disposal	
Site confirmation	Incident reporting	Establish on-site command	Dispatch collaborative units
Prepare emergency supplies	Enterprise alarm	Park site disposal	
Pre-emptive disposal of enterprises		Environmental testing	
Enterprise and park information release through radio and other means			
Alarm lifting	Evacuation of units	Exercise evaluation	

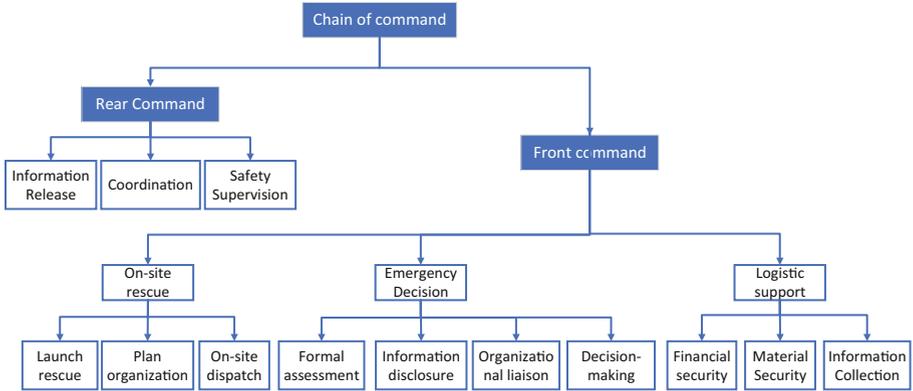
**Fig. 4.** Time series of each module of the emergency exercise

drill to clarify the process of each action link, and the action time is timed from the beginning of a certain link. Different time sequences are convenient to distinguish the task requirements of each link and the subjects involved. At the same time, it can be designed for the separation of multiple lines of work in the same period of time during the exercise, so as to guarantee the authenticity and rationality of specific action links.

(2) Clear command mechanism and precise division of authority relationship

In the clarification of command authority, the roles, organizational structure, responsibilities, procedures, terminology, and practical operation of the emergency command system are produced according to the incident unit and the coordinating unit to make the emergency command process clearer, more orderly, and more efficient. Drawing on ICS standardized command [10, 11], in small-scale incidents, the on-scene commander assumes all responsibilities, and in large-scale incidents, the on-scene commander is handled by both the commanding and coordinating departments. If the incident involves multiple units, the commander is determined according to the operational logic. The organizational command structure and the corresponding procedures in the exercise activities need to be consistent with the preplanned or actual disposal efforts (Fig. 5).

In the process of comprehensive exercises, involving cooperation between multiple functional departments and units such as public security, environmental protection, firefighting and medical care, the tasks of the emergency rescue team should be reasonably assigned and the articulation process between each department should



**Fig. 5.** Emergency Exercise Command System

be standardized. According to the business content, the actions and responsibilities that each needs to perform in each exercise session should be clarified, and according to the requirements of various plans, emergency forces should be integrated and deployed in a timely manner to strengthen horizontal cooperation as well as up-and-down linkage between various relevant departments to ensure the smooth implementation of emergency drills [12].

(3) Clear command mechanism and fine design of action links

The action of the emergency drill session needs to be designed according to the opinions of professional and technical personnel of the enterprise organization of process, equipment, safety, etc. of the on-site disposal program. At the same time, before the start of the drill, the necessary safety education and skills training need to be given to the participants to ensure that they are proficient in emergency disposal procedures and on-site emergency disposal measures [13–15].

## 6 Conclusion

The design and organization of emergency drills are of great importance for standardizing emergency response procedures, strengthening emergency command capabilities, improving the quality of accident disposal, and perfecting the information release mechanism. The main conclusions of this paper are as follows.

- (1) The main problems in the organization of current emergency drills are explained, mainly the lack of clarity in the arrangement of drill time sequences, the unclear interdepartmental command system and the irregularity of on-site disposal actions, and the reasons for these problems are analyzed.
- (2) Based on the characteristics of emergency events, an emergency drill process module containing six elements such as time planning, scene setting, command system, unit coordination, linkage response and disposal measures was proposed, and the role relationship between the modules and their functional design were elaborated.

- (3) The emergency drill organization method of modular process was applied to an emergency drill of an environmental incident in a chemical park in Shanghai, and the effect of the drill was summarized.

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