Constructing China's Total Emergency Management Model of Earthquake Disaster

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Abstract Public emergency management model is one field that emergency academics and practices have put emphasis on in the recent years. 2008 Sichuan Earthquake, an extraordinarily large earthquake occurring on May 12, 2008, was the largest to strike the mainland of China over the past 50 years which destroyed infrastructure and hurt human's lives seriously. Studies yielded information requested and raised questions about emergency management model for improving the performance in emergency management of earthquake disaster. This paper aims to construct China's total emergency management model of earthquake disaster. The related literature of earthquake disaster and emergency management is first reviewed. Then the deficiencies in the current emergency management are analyzed, followed by the expatiation of total emergency management concept. Finally, China's total emergency management model of earthquake disaster is constructed. Three core issues which should be emphasized in constructing total emergency management model are total course, total system, and total orientation.
Key words public emergency management, total emergency management, model, earthquakes

1 Introduction

With a considerable rise in the number of natural disasters, which contributes to increasing emergencies almost in every corner of the earth, public emergency management has attracted much attention in the academic field in the recent years. Among natural disasters, earthquake can be considered special disasters in terms of its unpredictable nature. When it is not possible to tell potential victims that well planned escape or fail-safe protection can be offered to them if disaster occurs, one is in a different situation that with escapable disaster. Even landslides, avalanches, and similar phenomena can be no-escape natural disasters on a small scale. China saved many lives by getting people to escape when the Liaoning Sea earthquake in 1975 was predicted. However, the prediction ability was quickly shown to be limited in 1976 when Tangshan was struck with the loss of 242,000 lives and the virtual destruction of the city. Earthquake prediction with any reliability is simply not possible as of the beginning of the 21st century. Earthquakes with disastrous consequence, while are not a regularly occurring event, actually result in enormous losses. A recent case is 2008 Sichuan Earthquake. Up to now, there have been 69,185 deaths and 18,458 disappearances from the Sichuan Earthquake.

In order to develop a sound basis for practical research for making recommendations to mitigate the impact of earthquake disaster on human life, the total emergency management must be considered. The purpose of this paper is to present a research framework to facilitate understanding China's total emergency management model of earthquake disaster. The related literature of earthquake disaster and emergency management is first reviewed. Then the deficiencies in the current emergency management are analyzed, followed by the expatiation of total emergency management concept. Finally, China's total emergency management model of earthquake disaster is constructed.

2 A Review of Earthquake Disaster and Emergency Management

2.1 Earthquake Disaster

There are common characteristics to describe a natural disaster: (1) has only negative effects; (2) causes large scale damage to human life and physical environment; (3) has large economic and social cost; (4) can be a natural or man-made event, or both. According to the characteristics of disasters, a disaster is defined as an emergency situation of some complexity that will cause the loss of lives, damage property and the environment, and hamper local social and economic activities.

Earthquake is one typical type of natural disasters. Earthquakes are usually closely related to plate tectonics. Once the friction bond or pressure holding together two ribs of a fault is broken, the elastic strain energy is suddenly released in form of an earthquake. At the very event, the earth experiences seismic waves. Large earthquakes can produce considerable horizontal and vertical movements in the range of meters. Earthquakes have claimed hundreds of thousands of lives in the last 100 years and improvements in technology have only slightly reduced the death toll. At the 1905 San Francisco,

California, earthquake, which had a magnitude of 8.3, horizontal movements exceeding 5 meters have been reported. During the period 1967–1991, there were 600,000 deaths from earthquakes (Kerpelman, 1994) [1]. China is located on several earthquake belts. In China, there were several serious earthquakes in the last four decades as follows:

(a) 12 May 2008: Up to 69,185 people are killed and as many as 374,171 injured. The tremor, measuring 7.8, hit 92km (57 miles) from the provincial capital Chengdu during the early afternoon.

(b) 24 February 2003: More than 260 people die and almost 10,000 homes are destroyed in Xinjiang region, in western China.

(c) 21 September 1999: Taiwan is hit by a quake measuring 7.6 that kills nearly 2,500 people and causes damage to every town on the island.

(d) 28 July 1976: The Chinese city of Tangshan is reduced to rubble in a quake that claims at least 250,000 lives.

2.2 Emergency Management

The disaster emergency management is management of emergencies attributed to catastrophic and disaster events. Emergency management generally concentrates on managing the immediate repercussions of the emergency, for example the media and public reaction, minimizing its impact on normal operations and ensuring the emergency response team is handling the incident in an adequate way.

Emergencies management depends heavily on acknowledges of the development model of a disaster or crisis. Turner (1976) [2] illustrated the sequence of events associated with the development of disaster, which was used by Toff and Reynold (1994) [3] as the system failure cultural readjustment model. A theoretical two-dimensional model has been developed in terms of what people are prepared to do in the emergency preparation. The model identifies societal level, individual level and the interplay between them (Larson and Enander, 1997) [4]. Mayer (1993) [5] summarized the disaster life cycle into four periods: normal operations; emergency response; interim processing and restoration. Tufekci and Wallace (1998) [6] suggest that emergency response efforts consist of two stages; pre-event and post-event response. Pre-event tasks include predicting and analyzing potential dangers and developing necessary action plans for mitigation. Post-event response starts while the disaster is still in progress. At this stage the challenge is locating, allocating, coordinating, and managing available resources. According to Fink (1986) [7], a crisis can consist of as many as four different and distinct stages: (1) prodromal crisis stage; (2) acute crisis stage; (3) chronic crisis stage; and (4) crisis resolution stage.

Based on the understanding of development of a disaster, appropriate disaster managements go beyond post-event disaster assistance; it includes pre-disaster planning and preparedness activities, organizational planning, public relations, and many other fields. Even to earthquakes disaster, which is well known in the world as its unpredictable feature, there are still chances to make pre-disaster planning activities and issue early-warning signals. Huang [8] argued the emergency management consists of several steps including the emergency risk identification, the emergency monitoring system, prevention and control of the emergency consequence and termination of emergency period. Tang [9]suggested it is necessary to study the strategies on how to improve the aseismic abilities of lifeline systems in Western China. In order to reduce the seismic risk of these on-going building and future building lifeline systems, he presents performance characteristics of lifeline systems in recent three earthquakes and analyzes their earthquake damage mechanism. Chen [10] put forwards the need to develop an applicable model for estimating the significant increases of earthquake loss in mainland China. Ma Zongjin [11] outlined the seismic hazards, earthquake prediction methods, and disaster mitigation programs in China. An engineering system was proposed to mitigate the damage caused by earthquakes. The system is comprised of a seismic monitoring system, a forecasting or warning system, better building codes, and rescue and relief programs.

These analyses have not explored the emergency management of earthquake disaster in a thorough and systematic manner. However, the methodology applied and the trends developed in the analysis can be used for reference to further research.

3 The Deficiencies in the Current Emergency Management Model of Earthquake Disaster

The development of earthquake engineering in China is delineated by three stages. The initial stage was in the 1950's to the 1960's. The first earthquake zonation map and the first seismic design code were completed and used in engineering design. Site effect on structural design and site selection were seriously emphasized. The second stage marked with the occurrence of quite a few strong earthquakes in

China, from which many lessons were learned and corresponding considerations were specified in China's design codes and followed in construction practice. The third stage is one of disaster management, which is marked by a series of government documentations, leading by a national law of the People's Republic of China on the protecting against and mitigating earthquake disasters adopted at the meeting of the Standing Committee of the National People's Congress of the People's Republic of China in 1997, and then followed by some provincial and municipal laws to force the actions outlined in the national law. Although a huge progress on the earthquake disaster management has been made, the current disaster emergencies management model has obvious deficiencies.

(a) lack of activities for proactive approach including prediction and warning for disaster occurrences;

(b) no specific responsible unit;

(c) lack of education and knowledge for earthquake in potential disaster effected communities

(d) slow decision making in national level for emergency relief activities;

(e) unclear line of command from top to provincial level authorities;

(f) logistic problems for distributing goods for emergency relief;

(g) lack of effective collaboration among institutions in different levels; and

(h) lack of information management or database system

Then the concept of total emergency management is necessary to overcome the deficiencies of current emergency management model, which is a new emergency management concept and consists of three characteristics: (1) Total course management; (2) total system management; (3) total orientation management.

4 Total Emergency Management Model of Earthquake Disaster

4.1 Total Course Management of Earthquake Disaster

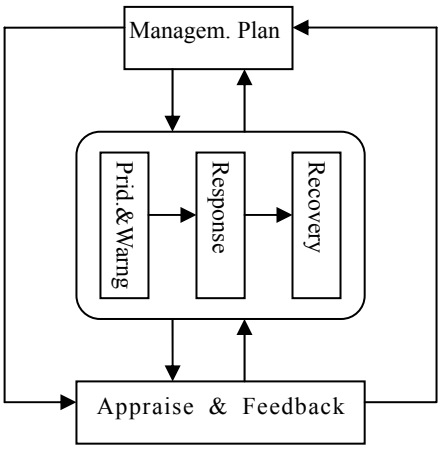

Figure 1 Flow of total course management

The total disaster management covers generic three phases, namely: (1) prediction and warning; (2) emergency response; (3) recovery. Before the three disaster management phases, disaster management plan is initially established, which will be applied in the duration of a disaster. After the disaster, the performance of disaster management should be appraised, resulting in feed-back information. Inversely, the feed-back information will be used to modify the initial management plan.

(1) Prediction and warning. In this phase, mitigation and preparedness activities are conducted in the prediction phase. This includes structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards and non-structural measures taken in advance to ensure disaster management effective response to the impact of hazards. Warning refers to the provision of timely and effective information, through identified institutions, that allows individuals exposed to a hazard to take action to avoid or reduce their risk and prepare effective response.

(2) Emergency response. The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of immediate, short-term, or protracted duration.

(3) Recovery. This phase includes decisions and actions taken after a disaster with a view to

restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk.

4.2 Total System Management of Earthquake Disaster

In order to satisfy the need to improve the efficiency of total emergency management, a system based on five functions is constructed (see Figure 2). The system consists of five sub-systems, which are command system, implement system, resources system, information system and supplementary system. And each of the three latter sub-systems contains several subsidiary systems. (1) Resources sub-system: emergency teams support, financial support, materials support, transportation support, medical support, communication support, infrastructure support, technology support; (2) Information sub-system: data base, case base, collect & process and transfer & issue; (3) supplementary sub-system: mechanism analysis, warning & prediction, resource optimizing, comprehensive appraise and decision & suggest.

Command system is the core of the whole system; the power from all levels, including UN agencies, main international NGOs, and regional and local governments or NGOs, will be integrated to serve for the disaster emergencies management. Under the direction and coordination of command system, the implement system is responsible for taking actions. Resources system, information system and supplementary system assist command system and implement system in disaster management from the resources, information and methods.

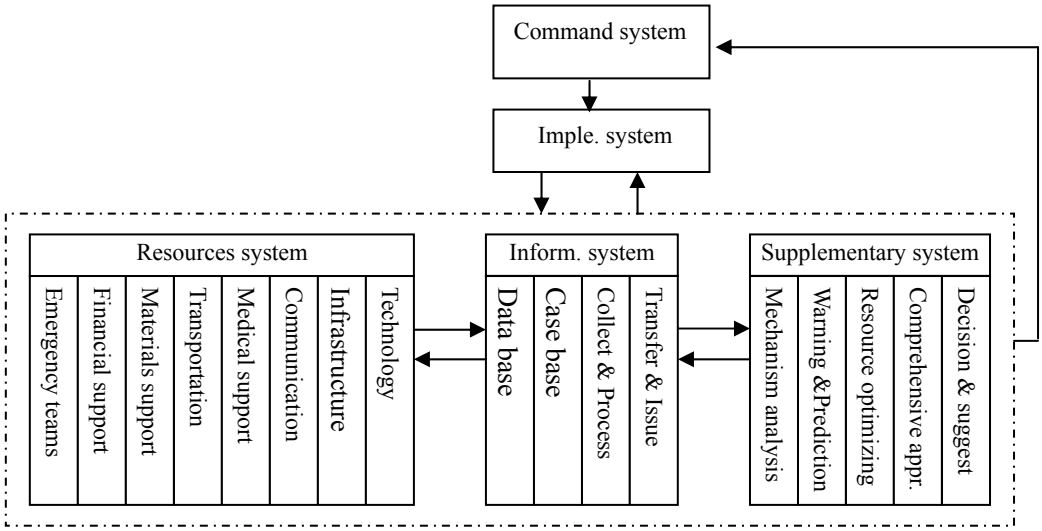

Figure 2 Total system management

4.3 Total Orientation Management of Earthquake Disaster

The earthquake disasters can be graded according to the extent. The common grades are Ⅰ, Ⅱ, Ⅲ, and Ⅳ. Different grade of earthquake involves different sections (See Figure 3). Coordination strategies, critical to disaster management, should be applied to state and local law enforcement and the relevant province and county government agencies, public and private medical centers, emergency warning systems, and relevant public and private organizations at the community level.

Under the globalization, disaster is the common challenge to human beings, so international cooperation is significantly important and should be encouraged in disaster emergencies management. Main operators in the international disaster management system comprise the governments, UN agencies, International Committee of the Red Cross, World Health Organization, and international NGOs. UN system will be the core of global disaster management. International NGOs will continue to play an important role in the disaster emergencies and are the main executing entities. The versatile functions of international cooperation consist of information sharing, technology communication, resources assistance and personnel assistance. Proper organizational and operational mechanism will be critical to promote the functions.

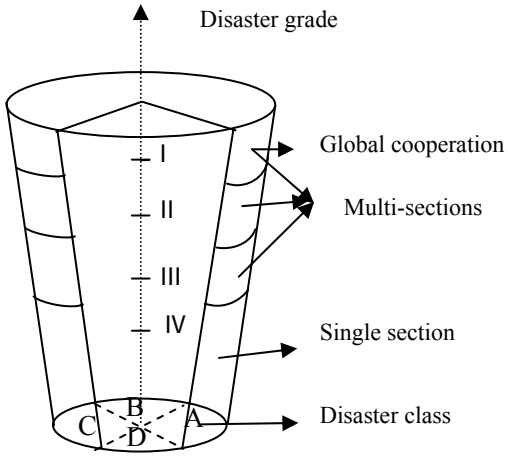

Figure 3 Total Orientation Management

5 Conclusions

2008 Sichuan Earthquake was the largest to strike the mainland of China over the past 50 years, which destroyed infrastructure and hurt human's lives seriously. From the tragedy, the current emergency management model possesses several deficiencies so that constructing emergency management model of earthquake disaster for improving the performance in emergency management of earthquake disaster is impending. The total emergency management is a new emergency management concept. China's total emergency management model of earthquake disaster should be constructed. Three core issues, being emphasized in constructing total emergency management model, are total course, total system, and total orientation. Further research should be undertaken to explore the mechanism of disaster management in depth, which requires combination of theoretical and empirical studies.

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