THE CONSTRUCTION AND EMPIRICAL ANALYSIS OF CAMPUS EMERGENCY MANAGEMENT CAPABILITY INDEX

By

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ABSTRACT

In recent years, campus emergencies tend to happen frequently, which severely makes a threat on campus' stability and development. Governments and universities in all countries pay more attention to emergency response and disposal and gradually put campus emergency management into an important part of education management. Thus, how to strengthen emergency management capability has become an important research topic to be solved. This paper focuses on the capability and explores more about a series of corresponding problems involving in it.

First, constructing an index system of the campus emergency management capability. It aims to reveal the formation mechanism of campus emergencies and build the theoretical basis for campus emergency management capabilities. Through the comparative analysis of campus emergency management between China and other countries or region like America, Japan and Taiwan, some ideas about establishing the index system are obtained. By integrating relevant analysis of management process,

functions and capability elements of campus emergency management capability, the initial draft of the index system is compiled, and then it is examined and amended for its scientificalness and rationality by expert interviews. Therefore, the campus emergency management capability index system is established including 4 first-grade indexes, 12 second-grade indexes and 36 third-grade indexes.

Second, building an evaluation model of campus emergency management capability. In this model, the initial weight of indexes in all grades is calculated according to the analytic hierarchy process (AHP) and then a judgment matrix is constructed by pairwise comparison, along with the data of expert questionnaire. In order to overcome the likely problem of poor transmission or inaccuracy in scaling during experts' scoring of AHP, the entropy method is used to amend the index weight, ensuring that it is more scientific and reasonable. Thus, the campus emergency management capability evaluation model including all-graded weights is constructed.

Finally, using the fuzzy comprehensive evaluation to do empirical analysis. With the interpretation of index connotation, the five-grade scoring system is adopted to determine specific evaluation criteria of the index and compile the questionnaire. 3 colleges and universities are selected to test campus emergency management capability by fuzzy comprehensive evaluation, and in combination with evaluation results, the corresponding problems and shortcomings are analyzed so as to put forward effective strategies and suggestions to strengthen the capability construction of campus emergency management in two aspects of education authorities and universities.

Keywords: Campus, Emergencies, Emergency management, Campus emergency management capability, Effectiveness, AHP

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CHAPTER 1

INTRODUCTION

1.1 The Issues and Background

As the global climate environment is deteriorating, natural disasters take place more often at the corners of the world. In 2004, the Indian Ocean Tsunami killed 230, 000 people across 10 countries in South Asia. In 2005, the American "Hurricane Katrina" landed in southern coastal areas with death toll of over 1, 300, leaving more than one million people destitute and homeless. In the same year, 78, 000 people died in the earthquake in Parkistan. And in 2008, the earthquake in Wenchuan, China caused about 70,000 deaths (xinhuanet, 2008). In such cases where emergencies occur frequently over the world, the campus, as a part of the society, cannot keep it alone and stay out of the affair, so there are also various emergencies rapidly rising in it.

So far, incidences of terror and violence have become increasingly worse around the world, and shootings in the United States are particularly at higher risk. After the "9 · 11" Attack, America has always been threatened by terrorists. According to statistics, the death toll caused by terrorist attacks has reached 3521 over 34 years from 1970 to 2014, but only since 2015, 8512 people have died in the shootings within one year. In recent two years, school shootings alone have been up to as many as 74, and one serious case lately happened at 10:38 on October 1, 2015 when the shooting began in a community college in the northwestern United States Oregon with 13 people died and

20 wounded (sohu, 2015). The United States is the only developed country where mass shootings happen every few months. According to statistical tables from *The Huffington Post* on the same day, in 2015, there had been 45 different scaled campus shootings, nearly half inside colleges and universities. And some statistics showed about 9000 people were killed (guancha, 2015).

In addition, there are some campus criminal affairs like the homicide case caused by the murder Ma Jiajue in Yunnan University in 2004, an intentional human poisoning case in Fudan University in 2013 as well as campus accidents such as 4 deaths in the fire happening in Shanghai Business School in 2012 and 1 death in the lab explosion of Tsinghua University. In June 1, 2016, a campus shooting occurred in UCLA, and 2 people were shot dead (Yang, 2016). Besides, the abnormal death toll of college students increases every year and its percentage has reached five over one hundred thousand while it is ten over one hundred thousand in the western countries.

These emergencies in colleges and universities are complicate in their causes, profound in their impacts and extensive in their presence, which cast tremendous threat on campus' stability and safety as well as a big warning to campus management. Therefore, it requires us of not only paying attention to students' daily management but emphasizing on precaution and solution of these emergencies. The crisis triggered by them imperils the normal teaching, management and life orders of teachers and students inside the school and it also does serious damage to the campus' external image and reputation and even has great influence on the stability and development of colleges and universities involved in emergencies.

Under such grave situation, it is of great urgency and practical significance to deal with emergencies for colleges and universities in different countries.

Emergencies are generally unforeseen, urgent to be disposed and can bring serious damage and widespread impact (random, discreteness, small probability). But the current incidents occurred in colleges and universities tend to be difficult to prevent and control, easy to intensify contradictions, harmful for the reputation of the school and throw extremely harsh repercussions (Liu & Dong, 2008). Therefore, issues related to campus emergency management have promptly been put on the important agenda. For today's colleges and universities, it has become a serious and urgent problem to be resolved, which is how to actively prevent emergencies that may occur on campus, effectively minimize the damage and maintain the normal teaching and life in order to ensure the safety of teachers and students.

We've found that campus emergencies are too numerous to be ignored by searching campus emergency on the Internet. Colleges and universities are important parts of the whole social emergency management system. Due to more dense population of college staff and imperfect emergency responses, they are likely to face the direct impact of various risks, so that potential problems cannot get enough attention they deserve, thus easily giving rise to crisis. Over recent years, campus emergencies show their complexity and diversity, so campus emergency management has gradually drawn attention from different sectors of the society.

To enhance campus emergency management, a comprehensive evaluation on the management capability should be made by getting to know the basic situation of

emergency management and finding out its shortage with purpose, so as to provide colleges and competent departments with scientific basis when they make decisions. Therefore, a comprehensive and scientific evaluation index system of campus emergency management not only plays an extremely important role in measuring and judging campus emergency management capabilities but also serve as the key to the success of evaluation.

1.2 Research Significance

Emergencies are important factors that affect the security and stability of colleges and universities. But when they do happen directly or indirectly, it will inevitably affect campus' normal operation, threaten school development and bring colleges and universities obvious or latent damage and even devastating harms. Thus, it is of tremendously theoretical and practical significance to ensure sound development of higher education, maintain security and stability and build up safe campus environment by strengthening and improving emergency management.

1.2.1 Theoretical Significance

According to the principles of campus emergency management process, the research makes a thorough analysis of emergencies and factors that affect the emergency management capabilities, which plays an important role in understanding the construction of campus emergency management capability. In studying emergency management effectiveness, the multi-dimensional analysis from cross-functional development to vertical structure of emergency management is of great theoretical significance for a

comprehensive and objective analysis of campus emergency management system. It is not only bound to reorganize but improve corresponding management theory. Besides, this paper presents the index system and evaluation model of campus emergency management capabilities to help advance the development and promotion of corresponding research.

1.2.2 Practical Significance

Establishing the index system is aimed to define the importance of campus emergency capability by the determination of index weighting and keep the usual warning both focused and comprehensive with clear distinction, thus ensuring processing efficiency of emergency. This paper proposes to apply risk management theory into emergency management among colleges and universities and establish early warning information platform for emergency management, which has a certain applied value to improve campus emergency management. Based on the effectiveness study of emergency management research, efforts are made to identify strengths and weaknesses in the response to emergencies and targetedly put forward relevant suggestions to actively promote and facilitate healthy development of campus emergency management.

1.3 Issues

1) Constructing a campus emergency management capability index system.

2) Building an evaluation model of campus emergency management capability.

3) Using the evaluation model to test the emergency management capability.

Based on previous studies, the paper systematically analyzes and defines the relevant concepts of campus emergency management, and identifies campus emergency as the research object of campus emergency management. According to the characteristics of emergencies and emergency management, this paper divides the types of emergencies, draws on the relevant emergency management theory to reveal the formation mechanism of campus emergencies and builds up the theoretical basis for campus emergency management. Through the comparative analysis of campus emergency management between China and other countries or region like America, Japan and Taiwan and comprehensive analysis on management process, functions and capability elements, campus emergency management capability index system is constructed and further checked and amended for its scientificity and rationality by expert interviews.

By using analytic hierarchy process (AHP) and pairwise comparison of indexes, a judgment matrix is established and then combined with expert interviews and questionnaire scoring data, preliminary weight value of each index is calculated, and finally their comprehensive weight values are amended by Entropy method. The analysis of the index connotation and the use of five-grade scoring system help to determine the specific evaluation criteria and construct campus emergency management capability evaluation model based on fuzzy comprehensive evaluation. Then, the evaluation model is used to test the emergency management capability and some reference is provided for the construction of emergency management capability by selecting some colleges and universities as samples to test the effectiveness with the model.

1.4 Definitions

The key proper nouns employed in this paper are campus, campus emergency, campus emergency management and campus emergency management capability.

1) Campus

Campus, referring to an institution of higher learning, in which citizens get higher education, is the general name of the university, college, vocational and technical college and junior college. It can include specialist, bachelor, master and doctor from the perspective of education background and training level.

2) Campus emergency

It stands for incidents which suddenly happen on or off the campus and quite connect with someone or something in the colleges and universities. The emergencies may bring out severe impacts on the universities or the society and need some emergent measures to be taken to deal with, such as natural disasters, terrorist attacks, violent crimes and security incidents, etc.

3) Campus emergency management

It mainly refers to inner connection, interrelation and interaction relationship among different kinds of control systems taken by all managing bodies when they face unexpected accidents in colleges and universities so as to prevent and resolve incidents, restore orders on the campus, safeguard the normal teachers and students' teaching and life and promote the healthy development of colleges and universities.

4) Campus emergency management capability

It is an ability of prevention in advance, treatment in the emergency and recovery afterwards, giving play to campus' functions of planning, organizing, commanding, coordinating and controlling to minimize losses and impacts caused by emergencies. Thus, the strict definition of campus emergency management capability is the ability of reducing emergency losses.

5) Campus emergency management index

It refers to the index number, specification and standard of measuring the management capabilities and levels, generally represented by data. Also, it can be divided into qualitative and quantitative index, absolute and relative index, descriptive and analytical index.

CHAPTER 2

LITERATURE REVIEW

2.1 Research on Campus Emergency

The related research contents of campus emergencies are mainly to define the concept of emergencies based on their characteristics, and then to divide main types of emergencies according to their natures.

2.1.1 Conceptual Research on Campus Emergency

The nouns related to the concept of "Emergency" are "Crisis", "Risks" and "Disasters". Li (2012) thinks the crisis highlights high risks of results, which mainly refers to the state where risk and opportunity coexist and burstiness is not the inevitable characteristic of crisis events. Eugene (2007) points out that risk mainly emphasizes the uncertainty of events in the future. Wu (2012) explains that the disaster focuses on the specific incidents including natural disaster and man-made disaster. Natural disaster refers to earthquakes, floods, tsunamis, landslides, forest combustion, and drought and so on. And man-made disasters include man-made arson, intentional injury and so on. There are some other scholars describing directly sudden disasters as hurricanes, earthquakes and other natural disasters in accordance with the nature of the incidents. In America, emergencies are also referred to as urgent events.

2.1.1.1 The Relationship Between Emergencies and Urgencies

Ji (2004) thinks that urgencies can be divided into general or significant events,

but actually the “urgency” is a neutral term, conceptually equivalent to “unexpected occurrences”. However, “unexpected occurrences” and emergencies are not the same. Anything as long as it occurs suddenly, can be called an unexpected occurrence, whether good or bad. Then urgencies with little or no harm or even opposite are all “unexpected occurrences”. But these are neither emergencies nor research subject of the emergency management or crisis management. The emergency, as a special term, is defined by its definition. Although the definition of emergencies is not the same, it is the event that can cause harm, so the fundamental difference between “urgency” and “emergency” is the harmfulness.

2.1.1.2 The Relationship Between Emergencies and Crisis

The famous crisis management guru Barton (2001) believes that “the crisis (events) is an event with uncertainties which can give rise to potential negative impacts. Such event and its consequences may do great harm to the organization and its employees, products, services, assets and reputation.” Seen from the classic definition, crisis events emphasize in two aspects, namely, negative impacts and serious consequences. But it is worth noting that there is no emphasis on the occurrence of sudden. Eugene (2007) points out more clearly that the crisis is unforeseen, but it does not mean to be not predictable, for suddenness is not a necessary feature of the crisis. And emergencies, from its literal meaning, can be immediately told that its necessary feature--suddenness. As the subject of crisis management, an emergency inevitably possesses the characteristics of negative impact and serious consequences of the crisis, so the crisis has narrow and generalized meanings. Narrow crisis refers to emergencies while generalized crisis contains not only

emergencies, but also incidents in overall sense, not all necessarily happening suddenly with negative effects and serious consequences. So it can be indicated that an emergency is actually a crisis that occurs suddenly. The relationship between them can be seen in the following figure.

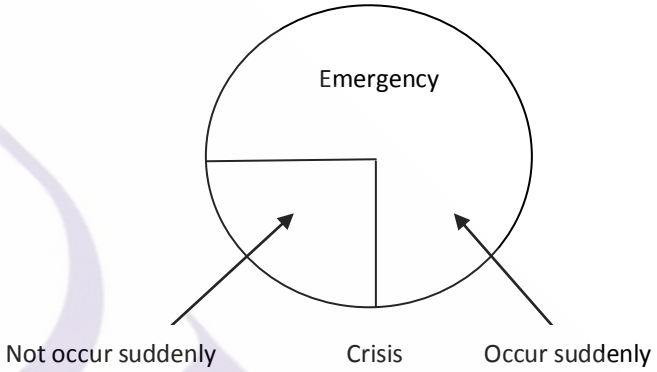


Figure 2-1 Relationship Between Emergencies and Crisis (drawn by the author)

Therefore, campus emergency can be defined as follows: a crisis that occurs suddenly on or off campus, quite connects to someone or something in colleges and may have serious adverse effects on the universities and colleges or even the whole society. It needs to take emergency measures to cope with.

2.1.2 Types of Campus Emergencies

Wang and Zhang (2006) divide campus crisis into four categories. 1) the natural crisis (occurring in the university) such as earthquake, torrential rain caused flash floods, typhoons, hurricanes, lightning, epidemic of infectious diseases and other natural disasters. 2) social crisis such as large-scale student strike, terrorist attacks, self injury due to the belief crisis, psychological crisis and the outlook on life frustration, and violence, etc. 3) the crisis of campus facilities such as building damage or collapse, use crisis due to improper use of computer software, network problems and computer virus

and damages to teachers and students caused by improper maintenance or improper, preventive measures and long-term failure to maintenance of school sports and health facilities. 4) the crisis of management in colleges and universities such as leadership change, leadership style, dereliction of duty, financial crisis, the crisis concerning source of students, academic corruption, the image crisis caused by teaching quality reduction, logistics management lag, large scale food toxicosis of students, loose security management, criminals invasion into the campus, and so on.

Wang (2007) classifies emergencies according to their natures. 1) Political emergencies. 2) Natural disasters emergencies. 3) Criminal and security disaster emergencies. 4) Public health emergencies. 5) Campus management emergencies. 6) Teaching emergencies. 7) Campus network emergencies. 8) Other public emergencies that affect school security and stability. Jian (2007) holds that it is helpful to facilitate the actual management of emergencies according to the classification, before, during and afterwards the emergency.

The classification of emergencies according to properties is still not the same, and there still exist incomprehensive or repetitive issues. In order to be convenient for the discussion on campus emergency management capability in the following, the paper divides emergencies into six categories based on their natures.

2.1.2.1 Terrorist Attack Emergencies

Colleges and universities are crowded places and campus attacks are more likely to be highly concerned for the government and community, so the terrorists and organizations are prone to regard campus as the object of terrorist attacks. According to

statistics, in the past two years, shootings alone in the United States have reached as many as 74, and a serious shooting lately happened at 10:38 on October 1, 2015. It was in a community college in northwest Oregon, the shooting caused 13 dead and 20 people injured (xinhuanet, 2015).

2.1.2.2 Campus Crime Emergencies

Campus crime not only pointing at teachers and students on campus, but also sometimes is taken illegally by them. The criminal activities directing at teachers and students have increased recently. According to statistics, there is higher rate in some cases where female college students are violated or suffer property fraud and malignant violent crime has also occurred often. Such crimes mainly are theft and robbery and so on. In addition, gang crime or campus crime with social members also happen occasionally. Although these crimes have caused no serious consequences and students involve in it for the first time with light penalty, this phenomenon and its development trend is worrying.

2.1.2.3 Natural Disaster Emergencies

The frequent natural disasters caused by environmental degradation require campus of urgent treatment. The natural disasters may do damage to campus mainly include floods, typhoons, hail, frost, snow and other weather disasters, earthquake disaster, geological disasters such as landslide and debris flow. Colleges and universities, as a unit of dense people, should strive to do a good job of natural disaster response and rescue work.

2.1.2.4 Safety Accidents Emergencies

Campus safety accidents consist of teachers and students' traffic accidents on and off campus, safety accidents due to the building facilities. Injury accidents are caused by participation in sports activities and other safety accidents like drowning, poisoning, electric shock, and experiments etc. In recent years, fire accidents in colleges and universities have become a major concern of safety accidents which easily lead to a larger scale of casualties.

2.1.2.5 Public Health Emergencies

Public health emergencies in colleges and universities are mainly related to infectious diseases and food hygiene. Due to dense population, infectious diseases and food hygiene emergencies have become the focus of campus emergency management. Campus is a place for students to study and live, in which there is dense population and close contact, giving higher rate of infectious diseases. Therefore, it is an important public health issue to strengthen the prevention of infectious disease on campus, which is of great significance to protect students' physical and mental health, maintain the normal orders of teaching and life and sustain social stability.

2.1.2.6 Psychological Problems Emergencies

Psychological health emergencies in colleges and universities manifest as psychological anxiety and depression of teachers, students, managers and college staff in the form. Since college staff suffers great psychological pressure which cannot be released effectively, the direct consequence is suicide or other dangerous behavior. There are some common psychological disorders among college students like depression, anxiety, obsessive compulsive disorder, interpersonal sensitivity, sleep disorder and

Internet and video games addiction. In colleges and universities, emergencies caused by teachers and students' psychological problems often occur, and especially in recent years, the suicide among college students has drawn general concern of the society and it still trends to grow.

2.2 Research on Campus Emergency Management

Based on the theoretical foundation of emergency management, the development of campus emergency management theory is sorted out in relevant research contents. Through the comparative analysis of campus emergency management between China and other countries or region like America, Japan and Taiwan, some ideas about establishing the index system are obtained.

2.2.1 Emergency Management Theories

The earliest research on crisis in western academia mainly focused on natural disasters. By the turn of 18th and 19th Century, crisis management research was gradually introduced into political field to study crisis events that states and government face (Roberts, 1991). In the western history, crisis management research has experienced two climax stages. From the beginning of 1960s to the beginning of 1980s, because of the change of world structure, the first climax of crisis research began in western academic circles and the crisis management theory appeared as an independent discipline (Adam, 2007).

Quite successful crisis management research is the research on enterprise crisis management since 1980s. In 1986, Steven Fink did a systematic study on crisis

management and established a more systematic crisis management analysis framework in his book *Crisis Managemen*t--planning for unforeseen crisis. Later, sudden public events showed some compound crisis characteristics such as high frequency, multi categories, agile radiation and enormous loss. In addition to traditional fire, earthquake, flood and riots, terrorist attacks, disease spread, ecological disasters and other new public emergencies have also grown, so that public emergencies become "normal" in social non-normality. More and more crisis events stirred up government's crisis management, and thus crisis management research appeared second climax. Due to the development of public management theory in this period, public crisis management became a new hot spot for scholars. Emergency management objects are mainly unexpected events, and they bring many difficulties in emergency management due to differences in the field and layout as well as different occurrence and development rules. It is necessary to carry out professional and targeted research and analysis on hidden crisis of major hazards, so as to develop a more complete response plan.

There are some important relevant theories countering emergencies such as Comprehensive Emergency Response Management Theory and Conflict Theory.

2.2.1.1 Comprehensive Emergency Management Theory

Comprehensive emergency management covers a series of links of public emergencies such as plan management, early warning management, emergency response, rehabilitation treatment, recovery, emergency management evaluation, feedback and improvement. It is a kind of management model of "Five Wholeness", the whole process,

the whole response, the whole means and the whole society, which is aimed at public emergencies (Yang & Wang, 2009).

Public emergency management refers to the intervention and control on all relevant parts of public emergencies with scientific methods in the entire period including before the outbreak, during the event and after the demise, in accordance with established emergency plan to reduce the loss caused by emergencies with the maximum. The whole system management of public emergencies includes command and dispatch system and disposal implementation system. The former is responsible for other systems in the process of dealing with emergencies, as the core of the whole system. The latter is the implementation sector of specific actions to guarantee the prompt and correct implementation of command and dispatch, including three subsystems, namely resource security system, information management system and aid decision-making system, which provide full support for the two systems above respectively from three aspects like resources, information and methods.

2.2.1.2 The Conflict Theory

The "Conflict Theory" refers to the theory that conflict has two functions-positive and negative. Negative function refers to the disharmony and conflicts between things while positive function is, under certain conditions, to ensure social continuity, reduce the possibility caused by the opposite poles, prevent rigidity of social system, enhance organizational adaptability and promote social integration and so on. If the conflicts between various groups in a social system cannot be handled correctly, it will hurt the feelings of the organization and its members, affect the unity and even

hinder the realization of organizational goals. Therefore, conflict is not "morbid" but "normal" for the society, just as a basic aspect of the social development. Conflicts are inevitable in the process of organizational change, and a certain sense it is the catalyst to promote the development of organizations (Coser, 1989).

The enlightenment of social conflict theory for group emergencies in colleges and universities.

1) College mass emergency itself has the conflict nature. As for the reasons, the group incidents originate from family backgrounds, school performance, teachers' attitudes and conflicts in values among classmates or between teachers and students. Seen from expression form, group emergencies are accompanied by different levels of conflicts, such as strike, gang fight, and even more radical conflict behaviors.

2) Conflict theories hold that mass emergencies exist inevitably in colleges and universities. The group emergencies are the results of long-term accumulation of various contradictions, and its rise is of objectivity and we should admit its inevitable existence and then resolve it, instead of regarding it as unreasonable behavior to suppress.

3) Conflict theory provides a perspective for objective and dialectical analysis of the functions of group emergencies in colleges and universities. The theory not only sees the negative effects but also positive functions of group emergencies in colleges and universities. This is the premise and basis to completely solve group emergencies and institutional policy innovation.

2.2.2 Campus Emergency Management

There are a lot of researches on emergency management (including colleges and universities) and fruitful achievements. In recent years, there are some representative points of views and studies from US Senate (2006), showing that, although the hurricane Katrina in 2005 was enormously harmful, most of casualties and property losses resulted from the government's failure to deal with such large-scale emergencies. Dilek and Erman (2008) have summarized scholars' research on the key factors of emergency management and have proposed corresponding models from factors in techniques, culture, socio-economics, politics, organization and risks, and finally subdivided them all.

Researches on the campus emergency management can date from 1980s when Coombs put forward the concept of "higher education crisis" in his book *The World Crisis in Education--The View from the Eighties*, explaining the creation and development of higher education at the micro level and pointing out some universal issues in global education. Since then, western scholars' studies on emergency and coping strategies have obviously increased. Among the scholars, Lerner (2003)et al have made countermeasure studies on campus violence and accidents and their achievement *A Practical Guide for Crisis Response in Our Schools* becomes a set of authoritative comprehensive response plan of campus crisis, ever referred by numerous schools in hundreds of countries and regions.

Some representative opinions in literature research are mainly as follows, Grayson (2006), Kadison and DiGeronimo (2004) think that counseling centers on campus not only deal with severe problems about psychological health but also undertake emergency intervention, control and post processing in consideration of pressure from all

sides. Grayson points out that, in view of campus community, there is nothing more important than preventing emergencies like intentional injury and murder, in which the toughest issue is how to find out the potential assailant. According to researches done by Zdziarski and Dunke (2007), Sherwood and McKelfresh (2007), as for emergencies like campus violence, all of contingency plans actually differentiate due to specific modes of execution, different implementation staff as well as constrains of territory, environment, culture and politics, although contingency plans in each system contain crisis management plan, threat evaluation panel and crisis response group. With regard to school district partner choice in emergency management collaboration, Robinson (2011) has certified that partner selection of school districts largely depends on strategic difference, according to the statistics about school district conditions in Texas Hurricane in 2005. From studies, Studer and Baker (2009) et al find that in most universities managers deemed that counselors should play leading role before, in and after the event. While Wiger and Harowski (2003) believe that when emergencies happen, managers have responsibilities to make plenty of decisions, which have exceeded the counselors' training and work.

As for specific implementation of emergency management, some campuses employ various intervention strategies that scholars put forward. For example, to cope with these emergencies, they arrange police and set metal detectors. However, Crepeau-Hobson et al. (2005) think that it is very important to prevent campus emergency, but some measures may give rise to more radical behavior in some cases instead of reducing occurrence rate. Rebecca and Herbert et al (2013) consider that the

prevention strategy should be on the basis of scientific research. The general precautionary measures is to reduce risks in uncertain crowds, such as lessening threatening behavior, identifying more direct information like confirming people who may show violence. In addition, when it happens, the campus should respond to it with corresponding plan at first to minimize the injury.

There is a great difference in the concept between emergency management and crisis management in colleges and universities. In brief, the former aims at campus emergencies and the latter campus crisis events. There are not only crisis events but also emergencies in colleges and universities and the latter belong to the former, so emergency management is the main and core part of campus crisis management. Campus emergency management refers to inner connection, interrelation and interaction relationship among different kinds of control systems taken by all managing bodies when they face unexpected accidents in colleges and universities so as to prevent and resolve incidents, restore orders on the campus, safeguard teachers and students' normal teaching and life and promote the healthy development of colleges and universities.

2.2.3 Analysis and Reference of Campus Emergency Management in Some Countries and Regions

Due to different historical factors and development stages of different countries, there are different characteristics and capability level in campus emergency management. According to some literature related to campus emergency management in many countries, it can be found that the United States, Japan and Taiwan and other countries and regions attach great importance to the campus emergency management and

they have relatively perfect emergency management mechanism and abilities. Among them, the American campus emergency management focuses on the prevention of terrorist attacks and campus crime. Japan focus more on responding to sudden natural disasters. Taiwan is similar to the mainland of China in general characteristics of campus emergency management. Therefore, this paper selects 3 kinds of campus emergency management respectively in the United States, Japan and Taiwan for comparative analysis.

2.2.3.1 Analysis and Reference of American Campus Emergency Management in the United States

1) Organization system of American campus emergency management

American emergency management system is set up in the continuous dealing with all kinds of frequent natural disasters, wars and human and technological emergencies, and is a fairly complete emergency management system built on the basis of the theory of "comprehensive management". By legal means, it integrates the comprehensive emergency plan, efficient core coordination mechanism, comprehensive emergency network and mature social emergency response capability in the system. While an important role of coordination played in this system is FEMA (The Federal Emergence Management Agency), whose mission is to "lead the United States for disaster prevention, response and recovery". It is an independent government agency that is directly responsible to the president, reporting and dealing with the country's disaster situation. Under FEMA, there is Director-General Office, National Preparation Office

and the Office of Strategic Planning and Evaluation as well as jurisdiction areas such as Regional Action Bureau, Sub-bureau for Preparation, Response and Reconstruction, Federal Insurance and Mitigation Sub-bureau, Fire Department and so on, responsible for collecting the information about folk disaster relief agencies or groups. At the same time, according to FRP (Federal Response Plan), the U.S. states and local governments have the main responsibility for dealing with emergencies (Chinese Academy of Safety Production Research Mission to the United States, 2006).

The campus is a typical public sphere, and its emergency management is closely related to the government's emergency management system. On the one hand, FEMA and all state education departments have formulated a series of guidelines for dealing with crises. For example, issued in the United States in 2003, "Practical Information on Crisis Planning--A Guide for School and Communities" clearly defined the types and stages of all emergencies as well as measures to prevent and respond to them. And after "9.11", the government has more stringent emergency monitoring and management on campus. The Federal Ministry of Education has highlighted the goal of building school security (Ye, 2002) in the U.S. Department of Education Strategic Plan 2002~2007). On the other hand, in response to the federal call, universities have also taken measures to strengthen the education of students' characters, civic awareness and patriotism, and set up an emergency management system suited to their own. In addition to Education Department, other departments such as Immigration Office has also taken corresponding measures to strengthen school security, especially strict qualification examination on students abroad from domestic universities, and requires the

establishment of background database of students in colleges and universities, for the government at any time to obtain (Zhang & Wang, 2013).

2) The operating mechanism of campus emergency management in America

The core of campus emergency management is the overall safety of schools. The Practical Information On Crisis Plan--Aguide for Schooland Communities in 2003 believes that the crisis of development include three stages, incubation period, outbreak period and recovery period. Crisis management includes four sections, crisis mitigation and prevention, preparation for crisis, response to the crisis and recovery after the crisis (U.S. Department of Education, 2003). The institutions of higher learning in the United States have developed their own safety programs in strict accordance with these four stages, and even some universities have made safety plans for each school building.

A. Crisis mitigation and prevention

The measure is meant to that schools and regions should mitigate and eliminate threats to life and property. Specifically, it is necessary for schools to conduct a safety evaluation of each building on the campus, which should include examining the school playground and lighting system to make sure whether there is risk, re-evaluation of the previous safety plan, good coordination with local industry, emergency personnel and parents when making crisis plan, risk evaluation of potential visitors and checking the traffic safety near the school. In the United States, campus police system is the most characteristic and campus police generally undertakes two functions. One is law enforcement, which is to investigate and fight against crime so as to safeguard the school

staff and students of the personal property and property safety in accordance with the law. On the other hand is safety management, which is to safely prevent crime and maintain campus security order, providing teachers and students with safety services. Furthermore, student affairs in American campus also have played a very important role in the relief and prevention of campus crisis. The affair group is mainly composed of psychological consultants, doctors, psychiatrists, Crisis Management Specialist (Zhu, 2014).

B. Preparation for crisis

The measure refers that the formulation of crisis management plan should be aimed at the worst crisis situation. Measures must cover various types of the crisis and corresponding countermeasures. Crisis management must adhere to the principle of life first, and it needs not only contact telephone number, alternate number of key agencies and people but also detailed plan of the school, the map of buildings and its adjacent areas as well as how to shut down and block the school or building and guidance for evacuation plan and procedural information. For example, No.1 crisis stands for the crisis that can be solved in the school level. No.2 crisis refers to the crisis that needs external help but can be controlled in school level. No.3 crisis is the crisis that the school cannot solve or control, desiderating outside intervention crisis, guidelines of communicate with the media, internal staff and public etc.. After the plan is formulated and approved, it must be regularly drilled, helping everyone know the emergency plan well, so that all kinds of personnel can be familiar with their action ways and routes in the crisis. As soon as crisis occurs, the plan can automatically activate.

C. Response to the crisis

After “9•11” event, the Department of Homeland Security, DHS has established a set of five-grade threat warning system, with five colors like green, blue, yellow, orange and red as symbols of this five warning grades from low to high, in order to achieve the change from the normal state to emergency. Institutions of higher learning in the United States have also developed guidelines for their own responses in response to different alerting states accordingly.

D. Recovery after the crisis

Once crisis plan is effectively implemented, the campus administrators are prepared to deal with the consequences of the emergency and take appropriate rehabilitative measures according to the severity of the crisis and the magnitude of the impact. In the recovery period, in addition to the possible early return to normal teaching work, the general will intervene mental health of college students or staff ahead of time. At the same time, the periodic review and evaluation of the crisis as well as the improvement of original plan is also an essential procedure. In addition, the campus will also prepare the lawsuit because the public and the management are usually held accountable.

3) American campus emergency management support system

A. organizational support

In campus emergency management, the traditional organizational system of the United States is a vertical model, namely, the implementation of the “federation-state-county-school district / school” four-grade management model. Among them, the federal level is the management of FEMA, which is divided into 10 regions

nationwide, with a branch set up in each district under vertical management. First, the principles of crisis management and operation mode proposed by FEMA are widely used in the formulation of crisis response plan. Secondly, crisis management courses such as "campus multi-risk prevention plan", "emergency management system for school application" and "Teacher's Manual for earthquake escape" are provided to universities. In terms of financial support, FEMA supports emergency management of institutions of higher learning through "public support funding" (Zhong, 2013).

The emergency management at the state level is a component of state agencies, which is not directly under the jurisdiction of the FEMA from the administrative point of view, the emergency management at the county level is similar to the state level. In accordance with the principle of decentralization of federal state, state and county emergency management departments undertake specific tasks of current crisis management and responsibilities. School district or school is the "first responder" of campus crisis management, and once campus crisis occurs, district or school must immediately set up a crisis response team (CRT) to carry out emergency rescue. Its responsibilities are as follows, drafting campus crisis response plan, evaluating and identifying potential risks on campus, carrying out crisis training, taking crisis rescue actions according to plans, and periodically reflecting and revising crisis response plans. For example, every student and faculty is given a thick student guide in the new semester at the University of Southern California every year, which including class policy, exam registration, sexual harassment policy, alcohol and drug abuse policy as well as a non-smoking policy, Student Association policy, noise policy, sales and fundraising

policy and campus use policy for roller skates and skateboards, etc.. Counselors will explain these policies to their freshmen during the week of admission. All of these rules and regulations are designated to prevent some minor events from becoming a major crisis.

B. System guarantee

American campus crisis management in the macro, intermediate and micro level has basically formed a complete set of detailed and specific, clear, clear responsible to response acts and practical guide from the "Campus Handgun Ban" to "Campus, Social drug control and Safety Law", from "the bill to improve campus environment to "Practical information on crisis planning--A Guide for School and Communities" and from the "Campus Security Act" to "Federal Emergency Plan". They effectively guarantee the effectiveness, timeliness and pertinence of the anti crisis operations. (United States Government Interagency Domestic Terrorism Concept of Operations Plan,2001).

C. Financial support

Each year, the Bureau of Finance in the United States gives at least hundreds of millions of dollars to help schools improve and strengthen the planning and implementation of emergency management. The United States uses special funds to strengthen campus emergency management, which provides a strong guarantee for the increasingly perfect campus emergency management system in the United States.

D. Social security

The anti crisis awareness on campus has permeated all walks of life in the

United States and runs through all aspects of university management. All sectors of society have paid more attention on American campus emergency management and each university has its own proper crisis plan, and therefore, the management of campus crisis has long been out of a post-mobilization mode of "emergency effort". The prevention of crisis has reaches unprecedented heights. (Xue & Zhu, 2013).

4) References for American campus emergency management

A. Establishing a scientifically structural system of emergency management

For American campus emergency management, there should be permanent organization for emergency coordination in national level, which guarantee the continuity of campus emergency management in policy and experience, helpful to improve emergency response system and learning. Some related command coordination can be unified, avoiding poor coordination of temporary agencies, reducing administrative costs and improving the efficiency of command. Secondly, various colleges and universities have established their own emergency management teams. The team members include the principal, vice principal, dean, doctors, nurses, and they have skills and knowledge to deal with emergencies in any emergency, and emergency management team usually carry out emergency management education and training.

B. Establishing a standard institutional system of emergency management

American campus crisis management in the macro, intermediate and micro level has basically formed a complete set of detailed and specific, clear-responsible

response acts and practical guide from the “Campus Handgun Ban” to “Campus, Social drug control and Safety Law”, from “the bill to improve campus environment” to “Practical information on crisis planning--A Guide for School and Communities” and from the “Campus Security Act” to “Federal Emergency Plan”. They effectively guarantee the effectiveness, timeliness of the anti crisis operations.

C. Strengthening emergency awareness and carrying out emergency training

At present, campus emergency awareness has permeated all walks of life in the United States and runs through all aspects of university management. All sectors of society have paid more attention on American campus emergency management and each university has its own proper crisis plan, and therefore, the management of campus crisis has long been out of a post-mobilization mode of “emergency effort”. The prevention of crisis has reaches unprecedented heights. In addition, colleges and universities in the United States begin to conduct emergency training irregularly, train students' reaction consciousness and ability in various kinds of simulation training, and develop administration staff's emergency management capability to coping with emergencies.

D. Developing an emergency management principle of “life is above everything else”

Emergency management aims to ensure the safety of teachers and students, which is the fundamental principle of American campus emergency management but also reflects “people-oriented” consciousness of modern public management, and therefore, it is also the basic principle of the world's emergency. Under the guidance of this principle,

we do not recommend and encourage teachers and students to “selflessly” get into dangerous sites, so as to ensure that teachers and students are as safe as possible in the emergency.

2.2.3.2 Analysis and Reference of Japanese Campus Emergency Management

1) Japanese campus emergency management system

A. Perfect legislation

The emergency management system in Japan is based on a sound legal foundation. Several major crisis before have made the Japanese government realize the importance of the law. At the same time, all walks of life also ask the government for legislation because of the serious consequences caused by the disaster. Therefore, in 1961, Japan officially issued the basic law called “Disaster Prevention Constitution” and “Basic Law of disaster countermeasures” which still plays a fundamental role in today's Japanese emergency management system. Although the law has been modified many times, its concept of “prevention by law and scientific emergency” continues to be improved. The law has greatly improved the disaster prevention system in the past and realized the systematization and legalization of the countermeasures. On this basis, many colleges and universities have formulated disaster prevention and emergency regulations, such as “School Safety Law” draft and “the Basic Process of Disaster Prevention in Osaka University”. In the crisis management process like prevention in advance, early warning, emergency response and follow-up work, universities should take actions in accordance with the procedures to ensure that disaster emergency can make everything in

good order and well arranged, thus minimizing the loss (Yao, 2007).

B. Positive disaster prevention education

For a long time, Japan has regarded disaster prevention education as uppermost priority and set up a "disaster prevention propaganda day" to carry out various types of disaster prevention simulation drills, so that students can get the real experience. Routine drills not only help students train their escape skills, but also helps them eliminate their fears in the face of disaster. In 2015, the MEXT (Ministry of Education, Culture, Sports, Science and Technology the Ministry of Education) published a survey and showed that in Japan there were 76% of schools among 54 thousand schools on their education over how to deal with the sudden crisis of natural calamities and man-made misfortunes. 76% of schools organizes students to do some training of preventing and responding to sudden crisis every year. At the same time, crisis management courses are also being opened in more and more colleges and universities and play a unique role. The Japanese government has also established various research institutions such as disaster prevention, environmental protection and health in the universities, thus forming an independent and relevant research system related to crisis management on campus (Huang, 2008).

C. Unified emergency organizational system

The universities in Japan have absolute autonomy, so no police can enter without the request or the consent of the university. But this does not mean that universities can deal with crisis accidents dependent of social freedom. Especially for the emergencies, the university can give immediate report according to school rules; police

and fire can immediately arrive and take emergency measures in accordance with legal procedures. The emergency management in Japanese universities adopts the public security management committee system, and the university administrators manage them according to the resolutions of the committee. The responsibility of the safety management committee is to plan and formulate basic plans and school safety policies and also set standards for school safety to conduct safety management in schools. When the crisis occurs, everyone must take emergency action quickly and methodically in accordance with the rules and regulations, without any violation of rules and regulations. The establishment of Safety Management Committee on campus can effectively manage the school safety in a unified and orderly way and better ensure the life safety of teachers and students (Yao, 2007).

D. Unified information collection management institutions

Japan has established information management institutions with cabinet intelligence survey room as the core under cabinet secretariat, responsible for collection, analysis, reorganization and comprehensive utilization of intelligence to strengthen the capacity of national centralized control on all kinds of disaster information. The organization has major responsibilities of overall commanding in information management. First, it is responsible for information collection, analysis and integration about the situation at home and abroad, domestic and foreign media views, scholars' suggestions as well as reporting important matters to the prime minister or Chief Cabinet Secretary at regular or at any time. The second is to jointly hold coordination meetings of information collection and analysis with relevant ministries and agencies. The third is

responsible for intelligence transmission between relevant ministries and the prime minister's official residence in the event of major disasters or emergencies and related information collection from public institutions of the folk according to the needs. To match with the major responsibilities, cabinet intelligence collection center is set up under the institution, equipped with latest multifunctional satellite transmission system, information security system of preventing information leakage and foreign invasion, the multimedia collecting national crisis management and multi-channel information communication system, to strengthen its capabilities of information collection, summarization and analysis information. With this institution, Japan, as a model, has achieved unified management of disaster information at different levels of government and relevant departments for the coordination of various departments, the efficient communication of disaster information and the scientific and accurate decision-making of disaster relief (Meng, 2007).

E. Developed information and communication facilities

Emergency communication facilities in Japan include five aspects. The first is the basic communication system with a telecommunication contact system set up among 54 organs. The second is the satellite system. There are 28 disaster management organs able to communicate and exchange information via satellite. The third is broadcast network, including central disaster prevention wireless network, the prefectural disaster prevention administrative wireless network and municipal disaster management administrative wireless network, which is ready to timely communicate with wireless system once the wired communication network is destroyed. The fourth is that a

helicopter in the air directly observes the disaster relief site and sends information to the disaster relief command center. The fifth is the establishment of a municipal area disaster relief communications network to contact various disaster relief organs and store information related to disaster management. Therefore, once a major crisis occurs, disaster information can be quickly sent to all parts of the country through the national communications network in order to do emergency preparedness (Li & Nie, 2009).

2) Japanese campus emergency management operation mechanism

It is very important to do emergency treatment for emergencies that have occurred, but it is more important to estimate danger and take precautions before an emergency occurs. Therefore, universities in Japan have set up a school security emergency management system which combines school crisis's prior prevention, disposal and supervision and feedback after emergency, (Xiao & Wu, 2009).

A. Prior prevention

First of all, disaster prevention drill plan is formulated and a series of disaster prevention simulation drills are implemented, so that both teachers and students can experience disaster and become familiar with disaster emergency procedures thus to eliminate fear. Secondly, principals and teachers must be alert to dangerous information and make careful precautions in advance so as to prevent accidents. At the same time, more attention should be paid to the collection of information related to emergencies so as to avoid the recurrence of similar accidents. Finally, emergency medical supplies on campus should be fully prepared and instruct teachers and students to use these materials correctly. What's more, principals and teachers should define their respective

responsibilities and be prepared fully for the worst of the incidents.

B. Disposal in emergencies

The first step is to rescue the injured, quickly start the campus emergency plan, and then dispose emergencies with combined efforts from the whole school. Secondly, it is important to deal with emergencies happened already correctly and calmly so as not to do further harm and try to avoid panic to schools and society. At the same time, efforts should be made to timely collect emergency information, make a clear decision after collation and analysis and announce the result to the school teachers and efforts. Finally, it needs to find out causes of the accident and guide the responsible person by educational means and then punish the responsible person for the accident.

C. Supervision and feedback

The supervision of the news media is an important part of the School Emergency Supervision and feedback system. Japanese school rules for information disclosure has the following provisions, publishing recorded publicly available information to journalists and paying attention to protecting the privacy of students and parents. Making a detailed description of some problems that journalist cannot deal with temporarily. As for the injury accidents caused by quarrels and insults among students, the position of campus should be explained in detail from the perspective of protecting the right of privacy between the two parties. When answering questions, the principal and other relevant personnel should agree. Guiding journalists to stand in the position of education and report events to their parents. In addition, various information networks can also be established on the Internet to collect information, opinions and solve relevant

problems in a timely manner. Teachers and students should work together to ensure the safety and stability of the campus.

3) Japanese campus emergency management support system

A. The Japanese government attaches great importance to national disaster prevention education. Every year, there are some regular and irregular anti-disaster drills conducted to make the people fully familiar with the disaster prevention process. Through the combination of schools and communities, drills should be carried out based on regionally Independent disaster and disaster prevention education with students as the regional disaster prevention undertaker.

B. The Japanese government takes the "student's life sustains the nation's future" as the highest criterion and builds support facilities for schools as the first refuge after disaster. Because of the geographical environment, the earthquake resistance of Japanese buildings is very high, and school buildings are stricter. It can be said that school buildings are the most solid in Japan, but also the most assured refuge for people after the disaster.

C. The Japanese government sets up many "disaster prevention resources warehouse" around the school and reserves all relief supplies and equipment required for the school and the surrounding community. At the time of the disaster, these materials can be sent to schools immediately to ensure the basic life of teachers and students and the surrounding citizens. At the same time, some simple facilities can be provided for the rescue operations.

D. Japan has perfect laws for disaster prevention and relief, and

colleges and universities have also formulated corresponding disaster prevention and disaster relief regulations and procedures on this basis. At the time of the disaster, it can be fine for university teachers and students to save themselves or rescue mutually step by step only in accordance with the provisions of regulations and procedures (China to the general office of the State Council to the emergency management of Russian and Japanese delegation, 2007).

4) Reference from Japanese campus emergency management

A. Perfect emergency management legislation

The Japanese government attaches great importance to the cultivation of national crisis consciousness. It emphasizes the education from the primary school by carrying out all types of emergency knowledge, skills learning and a variety of emergency drills, so as to keep its countrymen unruffled in case of response to emergencies at young age. Japan is one of the most perfect countries in the world for emergency management laws and regulations. And Japanese universities have made corresponding emergency regulations and plans according to laws and regulations, which have played an important role in dealing with emergencies.

B. Unified emergency management organs

From the experience of Japanese universities, a unified emergency management organization is a necessary condition for effective handling of emergencies. A country should set up an emergency management system for the national education system centered on prior prevention, the effective disposal in the affair and the post-guarantee. At the same time, colleges and universities should set up their own

emergency management departments according to their actual situation, take precautions against unexpected incidents on campus and draw up corresponding emergency plans.

2.2.3.3 Analysis and Reference of Taiwan Campus Emergency Management

1) Campus emergency management system in Taiwan

In order to deal with the increasingly serious problems of campus safety, the education department in Taiwan has set up a set of emergency management mechanisms from central to local areas, so as to minimize the occurrence of campus disasters. Taiwan Ministry of education has formulated the "Key points for the implementation of the campus disaster management mechanism by the Ministry of Education" as the basis for the establishment of campus disaster prevention and rescue system in Taiwan. The administrative department for Education in Taiwan divides events involving campus emergency management into eight categories, campus accidents, campus security maintenance events, campus violence and behavioral biases, conflicts between teachers and students, children and youth protection events, natural disasters and other campus affairs, disease events (China Institute of Contemporary International Relations Crisis Management Countermeasures and Research Center, 2013).

2) The operating mechanism of campus emergency management in Taiwan

The universities in Taiwan divide the emergency management process into four stages, mitigation, preparedness, response and recovery (Liu, 2004).

A. The stage of mitigation. The purpose is to reduce disaster's occurrence or prevent its expansion. The main contents include analysis and assessment on the potential disaster, budget writing and implementation of disaster prevention, publicity education and training of anti-disaster knowledge, inspection and strengthening of old buildings, important buildings and anti-disaster facilities on campus, the establishment of disaster information network, the establishment of disaster prevention support network and other related matters.

B. The stage of preparation. The purpose lies in the effective implementation of emergency response measures, mainly including reserves of relief supplies and equipment, disaster collection, notification as well as communications facilities construction and purchase, maintenance and strengthening in campus security center, drawing contingency plan and establishing emergency response procedures, carrying out drilling simulation, storing materials and equipment for disaster prevention and rescue, hostling and maintaining shelter facilities and other emergency preparations.

C. The stage of response. Mainly to design series of operating systems of processing, organizing and reporting aimed at potential danger or the risk that has occurred. The measures are as follows, setting up an emergency response team, holding group meetings, the disaster collection and loss check and report, emergency care for the affected students, acquirement and use of relief supplies, cooperating with relevant units to set up temporary shelters, preparation of restoration work, a complete record of disaster response process and other disaster response and measures of preventing the expansion.

D. The stage of recovery. The main implementation issues include the investigation and identification of disasters, recovery funds raising, the allocation and management of donated materials and funds besides relief payment, restoration of hardware facilities, psychological counseling of victims, students school aid, resumption of schooling and resumption guidance for students, have review meetings and other matters related to reconstruction after disasters.

3) Taiwan campus emergency management support system

A. Organizational support

Taiwan has established the central (Ministry of Education), local and school safety notification processing center, a three-grade networked emergency management institution, and school security centers at each level are special agencies for emergency management. For all education administrative units and schools to implement the campus disaster management, it needs to actively integrate administrative resources, construct campus emergency management mechanism and implement disaster alleviation, preparedness, response and rehabilitation. To make previous work practical, all educational administrative units and schools shall establish a campus security and emergency rescue notification processing center (hereinafter referred to as the school security center) as the operating platform of the campus disaster management mechanism. The "central" level consists of "the central disaster response center" and "Ministry of Education" and campus disaster notification processing center", the "local" level consists of 19 "branch areas", while 155 school security centers in junior colleges lie in the third grade. Three-grade campus security center is self-contained and network with other state

institutions, local government rescue units, making the whole campus disaster system into a part of Central Disaster Response Center in the executive department (Zhang & Li, 2007).

B. Legal guarantee

In 2001, the promulgation of Disaster Prevention and Rescue Law, the first reference law for disaster prevention and rescue in Taiwan effectively guided the prevention and rescue of major disasters. The Ministry of Education of Taiwan has established the campus safety and disaster prevention and treatment notification processing center in accordance with the disaster prevention and rescue law and has integrated the notification and disposal of campus events at all levels (Zhou & Zhao, 2015).

C. Social security

In Taiwan, the consciousness of emergency management has permeated all walks of life. All social classes have paid more and more attention to campus emergency management to put it on the agenda. The authorities also emphasize publicity, education and training of emergency management knowledge to improve the quality of emergency management personnel and public ability of self-help and mutual aid. In addition, the authorities also pay attention to the timely release of relevant information, which can effectively solve the problem of information asymmetry between the government and the public, and meanwhile they actively listen to the opinions of experts, thus creating a public and fair atmosphere and reducing the external pressure for handling unexpected incidents (Yang & Army, 2013).

4) Reference from Taiwan campus emergency management

A. Strengthening the preparation of emergency management plans for all kinds of emergencies. At present, Chinese has promulgated and implemented the "emergency management law", and all colleges and universities should combine with the preparation of the features of campus emergency events for all kinds of emergency management plans, in order to follow in dealing with all kinds of emergencies, according to the procedures, so as to better guide the emergency management of emergencies.

B. Reference from Taiwan universities emergency management. The establishment of emergency management institutions should be based on the principles of well-arranged structure, clear responsibilities, close ties and integration of resources. Effective management of campus emergencies can be achieved with the best combination of resources and low management costs by adhering to "people-oriented" and using school administrative and financial resources.

C. Actively establishing a crisis warning mechanism. As emergencies are unexpected and sudden, we should actively establish a crisis warning mechanism, in order to stop emergencies in the bud or to minimize the risk.

D. Strengthening emergency plan drills. We should learn from Taiwan campus in strengthening emergency plan drill, integrating emergency resources and continuously improving the scientificity and feasibility and operability to keep teachers and students calm down in face of emergencies and disasters by frequent drills.

E. It needs to increase the publicity, education and training of emergency management, so that teachers and students can master various methods and

ways of self-help and mutual aid. Reducing the difficulty and pressure of managers in the implementation of the program can help create a good atmosphere for emergency management.

Table 2-1 Contrastive Analysis of Campus Emergency Management in Some Countries and Regions

Country / Contents	America	Japan	Taiwan
Management System	Federal Emergency Management Agency (FEMA) consists of The Secretary's Office, Office of National Preparedness, Strategic Planning and Evaluation Office, having jurisdiction over institutions such as regional Operation Bureaus, Sub-office of Preparation, Response and Restoration, Sub-office of Federal Insurance and Mitigation and Fire Administration. The U. S. state and local governments take on the primary responsibility of dealing with emergencies.	It has passed Disaster Countermeasure Basic Law which is called "Disaster Prevention Constitution". It makes disaster prevention education a top priority and sets up "Disaster Prevention Awareness Day" when all kinds of emergency prevention simulation drills are carried out. Campus emergency management adopts the mechanism of Public Security Management Committee. Campus administrators carry out management in accord with the committee's decision. Under Cabinet Secretariat, Information Management Organization centered on NaikakuJouhoChousashitsu has been set up. It strengthens intensive control over all kinds of disaster information. The	The Ministry of Education has set up a complete set of emergency management response mechanism from central to local levels. "Implementation Points of Campus Disaster Management Mechanism Established by the Ministry of Education" has been regarded as fundamental basis of establishing campus disaster prevention and response system in Taiwan.

Continued Table 2-1

Country / Contents	America	Japan	Taiwan
		nationwide communication network can transmit disaster information to all parts of the countries immediately.	
Operation Mechanism	Crisis management consists of four processes such as crisis relief and prevention, crisis preparation, crisis response and post-crisis recovery.	Establish campus security emergency management system integrated by pre-empty problem, in-process disposal and post-supervision and feedback of campus critical incidents.	Taiwan campuses divide emergency management process into disaster mitigation, preparedness, response and recovery.
Security System	Carry out the mode of 4-level supervision "Federation-State-County-School District/Schools". From Campus Security Law to Federal Response Plan, management of campus crisis in America basically forms a complete set of detailed and accurate, specific, goal-oriented and accountable response acts and practical guides in the macro, middle and micro level. Strengthen campus emergency management with special funds. Anti-crisis awareness has	Through the association of schools and communities, drills centered on regional voluntary disaster prevention and disaster prevention education which regards students as undertakers of regional disaster prevention are carried out. Establish support facilities as the first shelters after the disaster in schools. Establish "Funds and Goods Warehouse for Disaster Prevention" around schools. Based on sound laws for disaster prevention and control, schools also establish related rules and procedures for disaster prevention and control.	Establish 3-level networked emergency management institutions. They are security report centers from central (Ministry of Education), local to school. School security centers at all levels are specialized institutions of emergency management. According to Disaster Prevention and Response Act, "Ministry of Education" establishes" Campus Security Centers and Report Centers for Disaster Prevention and Control", which coordinate reports and disposals of events in schools at all levels. Emergency management awareness has been pervading in all sectors of society. Administering authorities strongly

Continued Table 2-1

Country / Contents	America	Japan	Taiwan
	permeated all sectors of American society and various parts of campus management.		emphasize the propaganda and education work of emergency management and timely release relevant information, which creates an atmosphere of publicity and credibility for handling emergencies.
Advantages for Reference	Establish scientific emergency management structural system. Establish standardized emergency management institutional system. Strengthen emergency awareness, carry out emergency training. Establish emergency management principle of "Life above All.	Perfect emergency management legislation. Unified emergency management institutions. Strengthen the construction of early warning systems. Strengthen emergency publicity and education. Unified emergency information systems.	Strengthen the establishment of emergency management plans for all kinds of emergencies. The establishment of emergency management institutions should conform to the principles of distinct gradations, clear responsibilities, close contact and unifies resources. Actively establish crisis early warning mechanism. Reinforce drills of emergency plans. Promote the publicity, education and training work of emergency management.

2.2.3.4 Contrastive Analysis of Campus Emergency Management in China

1) Weak awareness of campus emergency management

Chinese universities have generally not taken emergency management as a part of campus management. Although regulations and plans about emergency management

have been established, they are often not specific or feasible. The comprehensive awareness of "campus emergency management" has not been formed. Schools are not aware that campus emergency management system is an interactive process coordinated by multiple subjects in and out of schools. Moreover, many campuses regard emergency disposal as campus emergency management, but they do not bring pre-event prevention phase and pre-event recovery and learning phase into emergency management. In fact, the most successful emergency management means that we should carry out is early warning and precaution during the latent period of emergencies but not take actions after emergencies. It is the misunderstanding about emergency management (Zhang, 2009).

Many teachers and students in Chinese universities have weak crisis awareness. Though alert in campus crime and violent incidents, they are not alert enough in emergencies such as earthquake, epidemic and fire disaster, and they lack knowledge and skills for escape and rescue. Crisis awareness is the starting point of emergency management and strong crisis awareness is helpful to reduce emergencies. Leaders in Chinese universities mainly focus their efforts on school teaching and research. But they give little care to training crisis awareness of teachers and students and they lack acute emergency judgment. Education departments at all levels do not bring crisis education into teaching system like America, Japan and Taiwan. Therefore, teachers and students in Chinese universities have weak crisis awareness in general.

2) Imperfect organization system of campus emergency management

China has also established accountable emergency mechanisms at all levels.

But hierarchic organizational system is imperfect and lacks statutory authority. There are no clear institutional functions as well as specialized emergency institutions such as FEMA in America, Cabinet Crisis Management Organization in Japan. Emergency management institutions are organizational guarantee for emergency management. At present, campus and competent authorities (such as Ministry of Education, Education Department of all provinces) generally do not have enough specialized and permanent institutions. There are more non-permanent institutions of strong temporality and uncertainty, consisting of temporary staff for some major emergency. Even if they work in the short term, long-term mechanism of emergency disposal cannot be formed. Moreover, most of staff engaged in emergency management is not professional and they do not get formal and systematic emergency management trainings, which are not beneficial to the implementation of campus emergency management. Based on international experience, China can establish a government-led permanent emergency institution which is in charge of management prevention, control and coordination all over the country. In the meantime, a nationwide campus emergency management system is established, which is led by the institution and based on Ministry of Education. As for particularities of universities, it establishes corresponding emergency management system and urges universities to establish emergency management operation mechanisms which conform to the realities of schools (Li & Xing, 2010).

3) Imperfect operation mechanism of campus emergency management

Because of backward ideas of campus emergency management, there are

inadequate emergency prevention mechanisms and recovery and learning mechanisms in designs of campus emergency management operation mechanism. First, there are imperfect long-term mechanisms for the collection, judgment and early warning of crisis information, inadequate training and regular drills against emergencies, and psychological interventions and guidance. Campus emergency plans are not specific and feasible. Second, there also exist deficiencies in campus emergency disposal process. Many universities have not set up specialized emergency management funds or requisite emergency material reserves. They hurriedly assemble funds and supplies when emergencies take place, which often results in ineffective emergency disposal. Finally, they pay little attention to evaluations and summaries of emergencies. Emergencies bring damage and negative effects, but they provide chances for learning and summing up experience and lessons. Making evaluations after emergencies and summarizing experience and lessons can prevent similar incidents from taking place again. After emergencies, Chinese universities only deal with the parties concerned and responsible individuals but they neglect evaluations and analysis of emergencies as well as summaries of experience and lessons, which is not useful for campus emergency management (Qin, 2013). Thus, universities should improve emergency management evaluation mechanisms, set up emergency case base and regularly organize relevant staff to learn and make summaries so as to conduct risk evaluation of other potential crises before they happen.

4) Impeded campus emergency information dissemination mechanism

After emergencies take place in Chinese universities, the school's management fears that a greater unrest will be aroused if information is spread, which can affect the image of schools, so they often drill strict control over information dissemination. Because of lack of information, informal and non-authoritative information distribution, on the one hand, as for campus emergencies, lots of rumors and assumptions will come into being on the Internet and the public's right to know cannot be guaranteed. On the other hand, the public and other social emergency forces cannot get accurate information, and then they cannot take part in campus emergency disposal timely and effectively, which makes unavailable adequate social security in campus emergency management (Li, 2010).

Through the above contrastive analysis, the article combines present emergency management and its features in China, focuses on the existing weakness and deficiencies of campus emergency management and forms corresponding indexes which are included into evaluation index system as the key point and direction of campus emergency management capacity building.

2.3 Research on Campus Emergency Management Capability

By analysis of the concept, this research analyzes campus emergency management capability from three dimensions of management process, management functions and capability elements, and constructs a three-dimensional structure system of campus emergency management capability.

2.3.1 Conceptual Analysis of Emergency Campus Management Capability

Capability means the necessary subjective condition to successfully complete an activity. It is interpreted as an ability of solving problems and finishing tasks (Modern Chinese Dictionary, 2012). Capabilities are obviously different in strength but their evaluation criterion is quite vague, which depends on the awareness of the evaluation subjects and index choice.

Emergency management capability usually refers to the management ability to deal with emergencies. Haddow (2008) holds that emergency management capability is about the ability of disposing and reducing the consequences and influences caused by emergencies, and it relates to the preparation before the emergency, response to the emergency and support and social reconstruction after the emergency.

This paper gives the definition of campus emergency management capability from the perspective of management functions, and combined with the process of emergency management, it is regarded as an ability of prevention in advance, treatment in emergency and recovery afterwards, giving play to the university's functions of planning, organizing, commanding, coordinating and controlling to minimize the losses and impacts caused by emergencies. Thus, the strict definition of campus emergency management capability is the ability of reducing emergency loss.

2.3.2 Process Analysis of Campus Emergency Management Capability

Fink (1986) divides the emergency management process into symptom period, attack period, continuation period and recovery period and the emphasis is on the prevention. The famous crisis management expert Heath (1998) put forward 4R theory. Reduction (i.e. for more effective management to emergencies through risk assessment)

Readiness, Response and Recovery, and the four-stage management theory of Heath has been adopted by Federal Emergency Management Associate (FEMA) in the United States.

Since the campus emergency management forms a systematic process according to emergency process, personnel involved and the loss caused in this system, a comparatively complete process principle is clearly drawn out from the prevention of campus emergency management, sudden outbreak of emergencies, the casualties and property losses and then to the rescue, recovery and reconstruction and the learning summary. According to this paper, seen from the vertical structure formed by time development of emergency management itself, the management capability embodies in these aspects such as prevention, disposal, recovery and learning. The subject of campus emergency management is an emergency, which is aimed to build a safe and stable campus environment, so that teachers and students' personal property safety and normal teaching as well as research activities can be effectively protected. In accordance with the development stages of emergencies beforehand, during and afterwards, campus emergency management is also divided into active prevention, quick disposal, rapid recovery, summary and learning and so on.

2.3.2.1 The Process of Preventive Capability

Although the campus emergency is inevitable, the usual prevention management can reduce the number of campus emergencies or reduce their damage, which is the important content of emergency management in colleges and universities and important means to respond emergencies. Jeffrey (2009) puts forward that prevention

management of campus emergencies can be decomposed and set up as organization and personnel construction, risk control and early warning, education training and drills, facilities and material reserves, etc. The preventive capability can be also embodied in such work.

1) Organization and personnel construction

The organization and personnel construction in campus emergency prevention management is a kind of emergency management construction conducted in normal state in which emergencies fail to happen. Organization and personnel construction includes organizational structure construction and talents team building, specifically in three aspects, organizational agencies construction, the proportion and professional quality of emergency personnel construction, and expert's team building.

A. The organizational structure construction

David (2007) mentions that there should be specialized emergency management organizations in the universities and colleges. Such organizations, with the advantages of profession and unity, are responsible for the management of various types of emergencies. A security officer should be designated in each junior college subordinate to universities and other functional departments to charge the emergency management in the corresponding department and regularly report work to school-level emergency management agencies. In addition, among the teachers and students, an information officer can also be set up and get trainings, responsible for reporting related emergency management information to the department and publicizing emergency management knowledge as well as other matters of contact.

B. Emergency personnel's proportion and professional quality

Edwards and Goodrich (2007) propose that professional emergency personnel in colleges and universities mainly include professional security personnel and emergency staff. The proportion actually refers that the number of emergency personnel takes up in the total number of colleges and universities. It can clearly reflect campus' capability to prevent emergencies. Tracey (2007) thinks that there are sufficient human resources in colleges and universities so it needs to make full use of such resources in emergency management, actively build up part-time security and emergency personnel team among teachers and students and organize volunteer teams, which can not only solve the practical problems of emergency management, but also improve teachers and students' safety awareness and techniques against unexpected events through part-time training and experience.

Emergency personnel's professional quality refers to their professional knowledge and skills of security and emergencies. For the professional personnel, they have to own qualification certification and work license while for part-time staff, they must get specialized training and practice.

C. Expert team building

With the growth of all kinds of campus emergencies and increasing professional fields involved, it is impossible for management personnel to master all professional knowledge in every field, so Lindell and Perry (2007) holds that a corresponding expert database should be established according to the type of emergencies. Thus, timely contact can be made with experts if necessary to provide scientific solution

or professional advice for emergency managers. For example, the psychological relief is an important part of the recovery construction of emergencies.

2) Risk control and early warning

Risk control and early warning is the key content of emergency management and prevention and also the specific prevention from campus emergencies occurring as well as an early warning and preparation for emergency in the future.

A. Emergency information platform construction

Moore (2009) points out that the obvious characteristic of emergencies is suddenness and urgency, so it is very important to transmit the information timely and effectively. The primary task of the emergency information platform building is to establish information transmission channels which are accessible internally and externally. Therefore, we can set up an emergency call for help uniformly in the colleges and universities. The key content of the platform construction is the network emergency information platform construction. The Internet has played an important role in the teaching and management of colleges and universities so that more attention should be paid to network in the transmission of emergency information and security knowledge. In the construction of campus emergency information platform, more endeavors should be made to strengthen the system of administrative duty, make full use of the convenient channels of information and enhance accurate and effective transmission of emergency information.

B. Contingency plan construction

The important role of emergency response plan in dealing with emergencies

has drawn extensive attention. Alexander (2002) thinks that the plan construction is a dynamic process and can play a real role only when full details about processing steps after emergencies are listed out and some dynamic modification and complementation are made in accordance with the previous disposal experience. But particular attention should be paid to the completeness and operability of emergency plans.

C. Risk evaluation and management

The risk management of campus emergency management mainly includes risk evaluation, classification, and intervention and risk transfer of all kinds of unexpected events. The first priority of risk management is risk monitoring and evaluation, which is, however, of great significance and responsibility due to varieties and uncertainty of the emergencies. Risk classification means to classify risks found and intervene events with high risk to thereby reduce the risk of events, thus playing a good role in preventing emergencies. Perry and Lindell (2003) believe that the intervention of high-risk events is the focus of emergency prevention work in colleges and universities and relevant prevention plans should be made for each inspection and evaluation project. For the irresistible risks, we should actively seek ways to transfer.

3) Educational training and drill

Educational training and drill serve as an important way to improve emergency management skills. Williams (2006) emphasizes that the lack of necessary training is the key to leading emergency response failure, so anyone needs to receive basic emergency training, including three aspects, safety publicity education, personnel training and emergency drills.

A. Safety publicity education

The importance of safety education can be embodied in many safety accidents such as the case of India Ocean tsunami in which a 10 year-old British girl Li Ti saved people. When the tsunami approached, Li Ti was on vacation with her parents in the beach of Thailand Phuket Island. Just a few minutes before the tsunami, Li Ti suddenly became frightened. She ran over to her mother and said, "Mom, we have to leave the beach. I think the tsunami is coming!" She said she saw a lot of bubbles on the beach, and then the waves suddenly came up. That was exactly what the geography teacher once described, signs that the earthquake triggered tsunami in the early stage. The teacher also said, there would be 10 minutes or so from sea water gradually rising to the tsunami hitting. At that time, the adults present were in doubt about what she said, but Li insisted them to leave immediately. Her warning quickly spread on the beach and all tourists evacuated from the beach within a few minutes. When hundreds of tourists arrived at the safety zone, there came tremendous sounds of the waves. Yes, the tsunami really came! That day, the beach is the only place on the Phuket Island coast where no casualties existed. The 10-year-old girl created a miracle of rescue with her knowledge (Chang, 2005).

Due to more and complicate content, it is difficult to design general teaching materials to unify the safety education standards and a quite ideal way is to design the content of safety education into rich reading materials combining with the characteristics of college students. From the perspective of the pattern of safety education in colleges and universities, in addition to the curriculum design, Kelly (2008) proposed to carry out

safety publicity education by making full use of other media. Especially the Internet has been very popular on campus, so how to effectively use the campus network to conduct security education is the important content of campus emergency management capability. What's more, emphasis should be made on examination and evaluation of effects in the process of safety and at the same time, it is a must find out the shortcomings in the work, improve them and make enhancing safety education effects practical.

B. Personnel training

Edwards and Goodrich (2007) point out that personnel training of campus emergency management should be given to professional personnel and teaching staff and students.

Emergency management professionals mainly consist of management personnel, security personnel and hygiene and first-aid personnel. Management personnel refer to a team dedicated to campus, security personnel are professional security workers, hygiene and first-aid personnel include both medical rescue personnel and psychological health consultants. The training for professional personnel should pay attention to the check and evaluation of professional quality and regular professional training and learning. The training for teachers and students mainly include all kinds of related skills such as emergency hedge skills, escape skills, first aid skills and defense skills, etc.

C. Emergency drill

Emergency drill is simulated drill of emergency capability for teachers and students in a state of emergency, mainly including earthquake hedging drills, evacuation drills and other content. Due to heavy work of learning and scientific research, it is hard

to spare their time in the normal study and life to organize emergency drills for college teachers and students, which is large workload, and in addition to drilling also requires some funding. At present, it is also a very good way to improve teachers and students' abilities of emergency hedging and escape by carrying out the "desktop deduction" or using network development simulation program to drill in the case of teachers and students being scattered.

4) Facilities and materials

Facilities and materials are essential resources to cope with emergencies in campus emergency management and prevention. They are the basis of emergency management in colleges and universities and also an important embodiment of the emergency management capability. In the views of Paeka and Hilyard (2010), facilities and materials mainly cover three aspects, safety facilities and equipment, emergency materials reserves and emergency funds.

A. Safety facilities

The safety facilities in the colleges and universities are the hardware foundation, so perfect facilities construction is the important guarantee for the prevention of campus emergency. Public health relates to medical facilities, campus accidents involving campus traffic, laboratory, fire control and other safety facilities and equipment, campus violence crime concerning video surveillance facilities and natural disasters relating to disaster prevention and mitigation facilities of lightening protection, earthquake proof and so on. In addition, campus emergency management facilities also include disposal emergency equipment in response to the inevitable emergencies, such as

special vehicles, special equipment, etc. For example, the rescue air-cushion, a kind of special equipment, can save people when someone falls down.

B. Emergency materials reserves

Emergency materials reserves refer to one-time consumption of goods and materials after emergencies, such as sanitation and relief supplies and life supplies. Based on the types of campus emergencies and characteristics, there should be appropriately emergency supplies reserved like some reserves for alternate source, power, temporary shelter and commonly used medicines and other necessary supplies.

C. Emergency funds

Capital investment is closely related to campus emergency management capability, and it is difficult to guarantee its efficiency without necessary and enough input. Emergency funds should be separately budgeted and supported by the financial department in colleges and universities, which cannot be embezzled or used at will but appropriately in accordance with the relevant provisions and complement in time after spending up.

2.3.2.2 The Process of Disposal Capability

The basic goal of deposing campus emergencies is to minimize harm and loss as much as possible and reduce the effects on the normal order as well as the safety and protection of personal property. Although the emergency disposal happens during or after emergencies and the event it itself is inevitable, the rapid and effective disposal still can minimize the damage and control its further occurrence. That's the important content of

emergency management in colleges and universities. Campus emergency contingency management includes emergency organization, command, coordination and control, etc.

1) The emergency disposal organization

The organizational work in emergency disposals is to organize institutions and personnel to cope with emergencies. Bigley and Roberts (2001) hold that the organization of emergency management institutions begins to work according to the types and natures of emergencies and mobilize relevant departments to participate in the emergency disposal. The organization of personnel is emergency staff's transfer and non-emergency staff's organization and transfer to jointly cope with emergencies. The organization of emergency disposal is the foundation and guarantee of orderly response to emergencies and needs to conduct timely, fast and orderly according to the emergency response plan arrangement.

2) Emergency disposal command

Campus emergency disposal command should be arranged uniformly by campus emergency departments. Rabasa and Blackwill (2009) think that the steps of emergency disposal command include launching the emergency plan timely, holding an emergency meeting and making decisions in time. The suddenness and uncertainty of emergencies often make the school unprepared, but the command of emergency disposals must realize the unity. When panics come in the scene, the unified command is an important support for assuring people.

3) Emergency disposal control

The control of emergency disposals refers to specific measures taken to deal with the emergency, whose purpose is to reduce the loss caused by the accidents and avoid further disasters. Because of urgency and seriousness of the emergency, more attention should be paid to quickness, accuracy and powerfulness. Quickness means that the response should be timely and rapid. Accuracy requires that it is a must to seize the key points of the event when making decisions and deployment. Powerfulness indicates that the decision and deployment must have a considerable strength so that the situation can be effectively controlled.

The main disposal measures in accordance with the emergency procedures include rescue for the injured, related personnel evacuation, blockade and siege of the scene, timely taking disposal measures, evaluation on the disposal, further disposal measures. After ensuring that personnel security is guaranteed, the intervention measures on the situation should be taken at the same time or immediately. For example, if the public health emergencies occur, inflection source should be immediately isolated, disinfected and prevented. Jillian (2008) thinks that after the first round of measures are implemented, relevant personnel should be organized to conduct a scientific evaluation on the situation and make judgments on possible developing trend of emergencies, and then immediate implementation of the second round of control measures should be made to avoid the occurrence of secondary disasters or other hazards. After that loop of evaluation and control of the process, the event is basically controlled and gradually subsided.

4) Emergency disposal coordination

The emergency disposal coordination of campus emergencies is also an important embodiment of emergency management disposal capability. In addition to the coordination of materials and staff, another important content is releasing information and guiding public opinions in the emergency disposal.

Campus emergencies, unlike large-scale natural disaster which needs to mobilize a large number of materials from the government, can be achieved as long as the facilities and emergency supplies reserves mentioned before are enough. In addition, when local emergencies happen in colleges and universities, emergency support will often be given by all walks of life, which is easy to solve the problem of materials. Waugh and William (2006) highlight that staff coordination refers to not only the coordination, communication and mobilization of relevant personnel on campus, but also the communication, coordination and cooperation with relevant departments, social relief organizations and stakeholders.

Public information release is the most important task in emergency management in colleges and universities. To this end, Wu (2005) proposes the strategy of information communication with the public in the disposal of campus emergency. Timely, open and accurate information release can eliminate people's fear and distrust, to avoid spreading false information and rumors, which is conducive to enhancing universities' reputation and the positive image and set up the determination and courage to overcome all difficulties.

2.3.2.3 The Process of Recovery and Learning Capability

The harm and impact that campus emergencies have made is difficult to be eliminated in a short time, so it is very important to recover and rebuild. As the opportunities and negative impacts brought from emergencies are worth thinking and summarizing, an important goal of campus emergency restoration is how to use the opportunity of emergencies to improve university management, transfer development of the situation and become positive from passive. Emergency management in colleges and universities concludes follow-up work and the rehabilitation construction and so on.

1) Follow-up work

Follow-up work consists of timely evaluation on the losses caused by campus emergencies as well as investigation for reasons and punishment to the relevant responsible person.

The loss caused by emergencies is divided into direct loss and indirect loss. The direct loss mainly includes the tangible life and property loss and the indirect loss includes the invisible loss of school reputation, teachers and students' psychology and so on. The loss caused by emergencies should be evaluated scientifically, which lays a foundation for scientific restoration and reconstruction.

Koliba and Mills (2011) think that parties responsible for the accident must be punished. To deal with the responsibility should not be hasty to act but be careful to make decisions before in the absence of clear facts. Penalties should be given in accordance with the relevant provisions in the universities, or relevant laws and regulations. For actions without breaking the legal responsibility, colleges and universities should respond in a timely manner according to their own situation. Acts of violating the law must be

held accountable strictly in accordance with the provisions of the law. The units and individuals who have outstanding performance in handling emergencies should be rewarded and be appreciated their contribution in the time of distress.

2) The recovery construction

According to the tangible and intangible losses caused by emergencies, the construction can be divided into the construction of facilities and equipment, reconstruction of teaching and management order, intangible reputation restoration and psychological counseling between teachers and students.

For the reconstruction of facilities, teaching and campus management system, it is necessary to realize that the reconstruction is not simple restoration. The crisis is not just a danger but also means a favorable turn. The process of recovery and reconstruction must reflect the "favorable turn". That is to use the opportunity of crisis to rationalize the existing unreasonable facilities and systems in order to prevent the occurrence of similar incidents.

Smith and Sandhu (2004) point out that Psychological counseling and assistance is also an important part of the construction of emergency recovery. The tragic scene of sudden events often leaves a shadow among teachers and students and difficult to eliminate for a long time. Cornell and Sheras (1998) make an analysis that unexpected events may have different influences on people's psychology. One is the parties can effectively cope with the crisis, so emergencies have no adverse psychological impact on them, and another parties can survive the crisis, but their hearts are still engraved in the shadow of the crisis. Then the adverse consequences of the crisis will often manifest later

in life, so the third kind of people have already had mental collapse at the beginning of the crisis. The first is the most ideal state, but also our pursuit of the goal. The second and third, is the negative impact of unexpected events on people's psychology, but the degree is different, which performs as the parties "panic, anxiety, fear and helplessness". A lot of psychological researches show that excessive panic, anxiety, restlessness, nervousness and excessive fear will weaken the body's resistance, reduce the psychological immunity, become more prone to illness and even can lead to irrational behavior, posing a threat to social stability and order. If the parties cannot get timely psychological adjustment and balance in the event of an emergency, they will be hard to cope with various pressures and show bad behaviors such as escaping, being autistic and impetuous and even evolve into serious psychological problems. For example, after the "9.11" terrorist attack in the United States, clinical psychologists in all aspects immediately devote themselves to rehabilitation to the escape, relatives of the victims and the general public, especially children's psychological trauma, which really did help to reassure people and reduce the loss. This kind of psychological assistance can be carried out individually or in groups. It can also be taken face to face, by telephone or on media.

3) Learning and review

Rebecca and Herbert (2013) propose that learning is of great significance for summarizing the experience in emergencies' prevention and disposal, so as to better avoid the occurrence of unexpected events and reduce the hazards of emergencies in the emergency disposal and reconstruction. The learning of campus emergency management includes case study and overall learning.

A. Case study

It mainly refers to the summary of each emergency on the campus. It needs to not only analyze the causes of events so as to find ways of preventing similar emergencies but also to analyze the process of emergency disposal and accumulate experience and methods of management. Scientific and correct analysis and judgment is the premise of learning summary of emergencies and the disposal process. Therefore, the occurrence of each emergency should be carefully analyzed, summarized, and formed into specialized archives. Non-confidential information and content or he information and content not involving in privacy should be open for discussion, learned and discussed publicly, while the information and content involving in privacy should be studied and discussed in a certain range to improve the emergency management capability of colleges and universities.

B. Overall learning

Overall learning refers to the learning process of all emergency management knowledge, which not only includes the security knowledge, the learning of various rules and regulations, but also different case study summary of campus emergencies.

Emergency management in the United States puts more emphasis on the summary of the study of cases to learn from it. Case analysis and collection is an important part of the emergency management work in colleges and universities. It will greatly enrich the experience of disposing emergencies in colleges and universities and improve emergency management capability by collecting the cases in this university and

some related cases in other universities, and even establishing special case files for foreign cases.

To this end, Liu and Zhang (2009) insist that there should be set up a special data room for cases to regularly release case information and provide briefing material to the leadership agencies of emergency management. The case information with value can be sent to the relevant departments to study and discuss, providing experience and information for the construction of emergency management capabilities. This is a very effective way to learn.

2.3.3 Management Function Analysis of Campus Emergency Management Capability

Henri Fayol's (1980) modern management theory holds that the basic five functions of management are planning, organizing, commanding, and coordinating and controlling. Therefore, the systematic research on campus emergency management capability should be carried out from campus' planning, organizing, commanding, controlling and coordinating aimed at emergencies, which can help deepen into the research.

2.3.3.1 Planning Function of Campus Emergency Management

Planning is an important reflection of campus emergency management capability. Judy (2007) points out that it is of great significance to develop an overall prevention, plan against emergency and mobilize people's active participation. Planning must be established on the base of correct analysis and judgment of current circumstances,

and then set up construction goals by stages to improve emergency management capability step by step.

1) Defining the current situation of emergency management

Knowing the current situation is the base for the next action. The same is true of campus emergency management. We must have a scientific evaluation and understanding of current campus emergency management capability and then we can relatively scientifically work out the next action plans.

Having a comprehensive analysis of every aspect of campus emergency management and defining weak links of campus emergency management can work out reasonable construction plans. In order to make a more detailed and scientific analysis of the structure and content of emergency management, campus must establish an overall evaluation index system which knows the constitutions of campus emergency management capability from different perspectives and grasps the laws of campus emergency management to grope for ways of improving campus emergency management capability from theory to practice. Thus, it is a very important basic task to have a scientific evaluation on campus emergency management capability.

2) Defining construction goals

Defining goals of the plan is the important content of planning. Defining goals should seek and focus on the construction of the weakest link of emergency management according to actual conditions of the campus. It should also emphasize overall improvement of emergency management capability and work out goals that should be achieved in definite periods.

Under current circumstances, institution and investment are main obstacles for campus to draw up detailed and feasible planning objectives of emergency management construction. Without specific daily emergency management institutions, or without special staff in charge of the planning objectives, it is always hard to achieve. So the organization construction is the primary task for improving campus emergency management capability. Fund investment is another important factor that restricts the construction of campus emergency management capability. It is difficult for campus to achieve large-scale investment only through campus economic power. They must raise construction funds in all kinds of ways. The government should play a leading role in investing funds for campus emergency management capability construction.

3) Defining construction progress

Restricted by resources and other factors, construction cannot be achieved overnight. It requires campus to set up construction goals by stages to guarantee the feasibility of construction goals. Once periodical construction goals have been achieved, and emergency management institution has discussed and passed, campus should carry out construction and complete construction schedule as planned. When a periodical construction schedule has been completed, campus should make adjustment and improvement of the plan according to actual conditions to ensure its smooth implementation.

Planning capability of campus emergency management is mainly embodied in preparedness plan construction in the process of emergency management. Now basically all campuses have established emergency preparedness plans, but most of these

preparedness plans are principal requirements and rough disposal procedures, which lack pertinent disposal measures and feasible operation methods. Of course, due to different campus emergency, disposal measures should be different. However, campus should at least list similar disposal procedures for similar emergency in details. As for all the possible circumstances, campus also should present disposal measures according to the actual conditions. In this way, feasibility of preparedness plan can be extremely improved.

2.3.3.2 Organizing Function of Campus Emergency Management

Organization work is the base of emergency management and important guarantee of improving campus emergency management capability. Rhonda (2007) points out that much campus emergency management organizing is relatively weak, mainly reflecting in lack of special daily organization institutions. We can learn good experience from campus in western countries in emergency organization institution settings. How to integrate existing organization institutions and redistrict functions of organization institutions is an important content of campus organization institution reform and modern campus system construction and it is also an important direction for further study.

2.3.3.3 Commanding Function of Campus Emergency Management

Commanding capability of campus emergency management refers to the effective exertion of leadership in face of emergency. In the special periods of facing emergency, there are special requirements of emergency disposal for leading work. Tong (2003) points out that environment of leadership makes a great restrictive function on

leadership. If we do not know specific environment of leadership, we cannot know the formation, operation and change of specific leadership, and also we cannot correctly understand and grasp the objective laws of leadership activities. From the perspective of the discussion on leadership, environment of leadership refers to time-space conditions and other factors that are related to leadership activities, including external conditions and factors such as natural, social, politic, economic and cultural ones. When only there is relaxing and stable environment of leadership, leadership can be exerted to the fullest. Special time and environment in which emergency occurs, the leader is required to exert different leadership art and skills. In this way, it can make leadership be distorted as little as possible and can display the leader's normal function.

2.3.3.4 Coordinating Function of Campus Emergency Management

Du (2008) points out that coordinating capability of campus emergency management is embodied not only in the process of campus emergency management capability construction but also in the disposal process of emergency. To improve emergency management coordinating capability, campus first should work out coordination preparedness plan. Once emergency occurs in campus, the public can know the fact, causes, measurements and effects, future trend of the event the first time through detailed communication and coordination preparedness plans, which can extremely relieve psychological panic caused by the event and reduce damage. Second, campus should emphasize the drill of coordination preparedness plan. Campus emergency coordination preparedness plans should not only be written in the paper, but also be put into practice. It is necessary to carry out regular or irregular training for people involved,

for it can foster the risk awareness and coordinating capability of people engaged, and can improve teamwork spirit and capability between man and equipment, man and man, institutions and institutions.

2.3.3.5 Controlling Function of Campus Emergency Management

Erland (2006) holds that controlling capability of campus emergency management is mainly embodied in the procedures of emergency disposal process. Sverre (2006) interprets that emergency management control capability is specifically embodied in reducing loss and damage of emergency by all kinds of measures and ensuring that there is no further damage and danger. Controlling capability comes from grasp of every kind of disposal measures for emergency. It also reflects overall disposal capability of campus emergency management. Control measure in fact is also the basic reflection of campus emergency management skill and capability. It is one of constituent elements of campus emergency management capability.

2.3.4 Influencing Factors of Campus Emergency Management Capability

1) Safety Education

Bai and Xu (2005) talk about whether to effectively reduce the possibility of the incident before the emergency and whether teachers and students can take immediate and effective escaping actions in the emergency, which is decided by the understanding of dangers, awareness and skills of teachers and students' self-aid and mutual aid to great extent. Therefore, it is a necessary element of campus emergency management capability to carry out safety promotion education.

A. Strengthening safety emergency knowledge education

Campus should set up relevant courses or regularly organize relevant lectures, trainings and activities to strength safety awareness of teachers and students, to improve their abilities of self-rescue, mutual-rescue, disaster prevention and escaping, and to help them master basic methods of self-protection, self-rescue, escaping and seeking help. Campus should develop relevant trainings against emergency for teachers and students, and regard emergency precaution, emergency command and comprehensive coordination as important contents to strength their capability to face emergency.

B. Strengthening health and hygiene education

Campus should offer health education courses to popularize public health knowledge of prevention against seasonal and emergent infectious diseases and control, organize specific education on food hygiene knowledge and food poisoning prevention, encourage teachers and students to enhance drills and improve teachers and students' public health awareness and their prevention and control capability of emergent public health events.

C. Strengthening law and discipline education

Campus should give relevant education on students to enhance their sense of law and discipline, and guide teachers and students to obey national laws, rules and regulations of school to decrease the possibility of crime. Campus should let students know basic law knowledge and enhance legal sense by offering basic law education courses or organizing vivid and interesting activities such as legal knowledge competition, moot court or case analysis. Campus should also emphasize school rules and discipline

education to develop students' good sense of discipline and restrict their unhealthy thoughts and bad behaviors so as to help them build self-discipline consciousness.

D. Strengthening psychological quality education

The first is to enhance psychological health education and promotion. Campus should carry out all kinds of promotion and education activities and offer psychological education courses and lectures in school in order to improve students' self-awareness and self-recognition ability, help students develop their communication skills, and learn various methods of actively solving conflict and pressure. Second, campus should set up special psychological consultative institution like network conversation platform of communication by phones, or face to face helping those who have psychological problem tendencies get psychological treatment and assisting them to solve psychological problems as soon as possible. Third, campus should offer trainings to teachers and other student management workers to prevent psychological crisis and help them grasp good methods of communicating with students to overcome and solve these psychological problems effectively.

E. Strengthening technical training and psychological guidance of emergency rescue team

Campus should put emphasis on specialized knowledge and technical training for emergency rescue team to ensure scientific and effective emergency rescue activities. Sun (2006) mentions that emergency rescue staff may undergo great psychological pressure in the rescue process. So we should attach great importance to psychological guidance of emergency rescue staff in daily trainings. To keep emergency rescue staff

away from psychological crisis after rescue activities, psychological consultative center on campus should also provide immediate psychological consultation for them.

2) Emergency Funds

Waugh and William (2007) point out that the funds for emergency management is often used up quickly and we need to make preparation in advance. Besides, special emergency funds should be also set up for daily emergency management, emergency research, construction, maintenance and update of emergency resources, emergency project construction and emergency preparedness funds. Daily emergency management expenses are mainly used for guaranteeing the smooth running of professional work of campus emergency management institutions, such as emergency management staff payment, daily activity expenditure, plan formulation and publicity and training and emergency management research expenses are mainly used for theoretical research of campus emergency management. In addition, other expenses for construction, maintenance and update of emergency resources are mainly used in their purchase, rent, repair and maintenance while emergency project construction funds are used for construction of emergency facilities, project development of emergency activities and cultivation of profession in emergency management. Emergency preparedness funds include expenses needed for emergent command and coordination of staff, institution running, scene rescue, equipment purchase and transport of emergency material in emergency, expenses for temporarily transferring non-campus facilities, and expanses for treatment and life relief subsidies of the injured.

3) Emergency Material Reserves

Huang and Li (2009) classify emergency material reserves into seven kinds of materials respectively for rescue, room and board disinfection, emergency transportation, power lighting, communication broadcast, equipment tools and general construction. Campus should establish a security system for emergency materials reserves, perfect the reserve, and transfer emergency distribution systems for important emergency materials. There are two forms of emergency material management, namely, normal management and abnormal management. They are different from each other but also closely related to each other. Normal emergency material management emphasizes more on the strictness of management, which requires taking actions step by step and stresses the fullest use of resources and the maximization of effectiveness. Abnormal emergency material management emphasizes more on the quickness of management and stresses quick exertion of emergency material efficiency. Normal emergency material management should be adaptable to requirements of abnormal emergency material management. It requires them to realize mutually quick transformation to form an organic material management system.

4) Emergency Knowledge

Knowledge and skills are supplementary to each other, which is an important reflection of capability against emergency. As is stated above, learning is an important way to gain knowledge. Knowledge means disposal experience and it plays an important role in preventing emergency and reducing damage in emergency. Qi (2003) divides knowledge into overt knowledge and covert knowledge from the perspective of knowledge management. Covert knowledge refers to procedures, policies, manuals and

plans that can be exactly described. Covert knowledge comes from experience, which cannot be definitely described. It is subconscious interpretation and application. It includes personal experience, beliefs, opinions and values, existing in experts' skills and minds of staff. But there is no clear distinction between them. They can interconvert to each other under certain circumstances.

We mainly gain knowledge by learning safety knowledge and case experience. General data and information needs to be processed, integrated and then converted into relatively systematic knowledge. The transformation of covert knowledge into overt knowledge requires constant discussions and learning in actual work and summary of practical experience and then we can make systematic and standardized arrangement. In emergency management, the concerned campus is unwilling to make some information known to the public, so it is difficult to collect full relative information. Therefore, campus should establish emergency archives primarily based on its own cases and then collect overt case information through open channels. This thesis will discuss the construction of campus management information platform, a complete emergency information report system established by education supervision departments. That is to say, supervision departments uniformly establish a shared information platform for all the campuses. Education supervision departments can make necessary arrangement of reported information files, delete the specific name of concerned campus and publish the case within the campus to enrich contents of campus emergency cases and offer experience and knowledge for campus emergency precaution and disposal measures.

5) Emergency Skills

Rui (2010) elaborates that campus emergency management capability refers to specific measurements and skills adopted in campus emergency. We can get skills from practice or by learning and drills. It is absolutely good to gain skills from practice, but nobody hopes that emergency often occurs on campus. As for common emergencies, campus can accumulate and summarize coping skills from the practice. But for especially serious and extremely unusual campus emergency, we can only achieve relevant skills by learning and drills. Achieving skills by learning in fact is to improve our own skills through others' practice. Therefore, we obtain abilities more by knowledge accumulation and group drills. It fully reflects that learning and drills play an important role in improving campus emergency management capability.

2.3.5 Structural System of Campus Emergency Management Capability

Above all, this paper makes analysis of the campus emergency management capability from three dimensions, the process, functions and the formation of capability elements. As for the process of campus emergency management, campus emergency management capability can be divided into preventive capability, disposal capability, recovery capability and learning capability. From the perspective of management functions, campus emergency management capability can be divided into planning capability, organizing capability, commanding capability, controlling capability and coordinating capability. From the perspective of formation of capability elements, they are the resource, knowledge and skills. As shown in the figure 2-2.

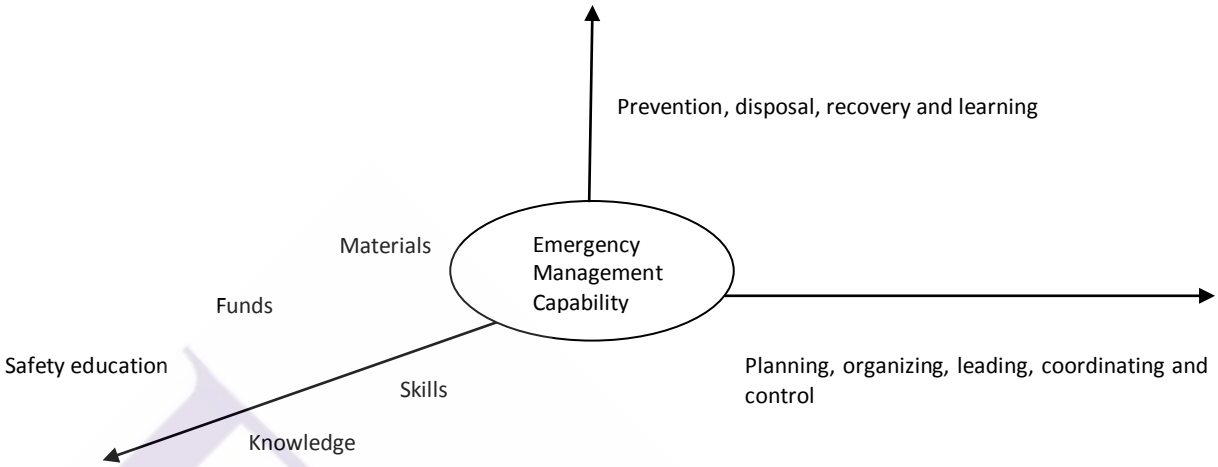


Figure 2-2 The Structural System of Campus Emergency Management Capability(drawn by the author)

The enhancement of campus emergency management capability must begin with comprehending the content roundly according to the reality, analyzing the weakness of management capability systematically and emphasizing on solving key problems of improving emergency management capability.

2.4 Research on Campus Emergency Management Capability Evaluation

The establishment of emergency management capability evaluation index mainly involves in many aspects like the selection of index and the setting and grading of index weight.

According to statistics, Zane and Bayleyegn et al. (2010) have evaluated the influence that Hurricane Ike had on the family community in Galveston as well as the correspondingly local public health sectors' response to it, and the conclusions showed that the departments concerned should strengthen public education on the prevention of

loss after the hurricane. Cornell and Gregory (2011) have ever made evaluation on a high school which applies "Virginian Student Threat Assessment Criteria" with the method of quasi-experimental research and indicated that the criteria indeed helped reduce the campus violence by 76%. Eileen and Stephanie, etc. (2011) have reviewed the literature on campus emergency plans and found the unique needs of campus environment failed to draw enough attention and the evaluation studies on the university campus emergencies just stayed at an early stage, and thus they established a model to assess campus management and reduce the threat. Borum and Cornell et al. (2010) think that as a very effective strategic approach, the threat assessment needs to be further studied, and later they outlines the campus needs, so as to prevent and reduce campus shootings and develop emergency planning for some crisis. Henstra (2010) draws on relevant research literature to determine 30 elements of efficient local emergency management program and integrates these key elements into a frame, which provides a method for the evaluation and implementation of emergency management programs. Simpson and Katirai (2006) argue that it is feasible to measure the evaluation on the readiness to respond to disasters with index. They proposed a set of disaster preparedness indexes to evaluate the preparation quality of disaster response. How and Tom (2006) also introduce an index system about disaster emergency capability evaluation. An Australian scholar (2002) has established an emergency capability evaluation system in eight aspects such as preparedness measures, mitigation measures, emergency response measures, disaster risk evaluation, disaster policy development, post-disaster evaluation, short-term relief measures and long-term relief and recovery measures. He employs the system to study

the advantages and disadvantages of emergency management measures that the Australian Government takes. Jackson and Sullivan et al. (2011) have described the reliability analysis process of emergency response system and put forward an approach to evaluating the emergency response system with a case for verification.

Hu and Zhu (2010) and et al have set up combined index system of campus emergency management capability evaluation in five aspects such as emergency warning, basic guarantee, rapid response, emergency disposal and emergency research management. They've also proposed to build an evaluation model of campus emergency management capability based on multi-attribute decision methods and confirmed evaluation index weight combining with information entropy and AHP. In addition, they make analysis and evaluation on the difference of campus emergency management capability among 5 universities in Nanjing, China.

Chen (2011) sets up an index system of campus emergency management capability evaluation based on the application of Hall Three Dimension Structure and analysis of time, logistics and knowledge. Rank Correlation Analysis can be used to define index weight and Experts' Grading can be used to define each index's scores.

Zhang (2011) has built the capability evaluation system from management supporting system, social satisfaction and systematic learning capability, early-warning system, processing system and recovery system, on the basis of balanced scorecard analysis framework and management system structure.

Considering the effect of risk factors in campus emergency management capability, Ji, Su, Lv (2012) has established campus emergency management capability

evaluation index system, which is based on organizational mechanism risk of emergency management, emergency preventive capability risk, emergency disposal capability risk and emergency recovery capability risk. And by using fuzzy comprehensive analysis, they have built a model to evaluate campus emergency management capability.

Although scholars have made positive contributions to building the evaluation system of emergency management capability and established different index systems to evaluate it, there still exist many problems in the process.

First, as for evaluation standards of the index, there are qualitative and quantitative indexes in the emergency management capability evaluation index system. But it is largely controversial on evaluation criteria and assignment of qualitative indicator. Most scholars assign values with subjective methods like Delphi or specialist meeting, while the objectivity and accuracy of the evaluation are based on evaluators' knowledge, ability and individual preference. If it is selected improperly, large deviation can be made, thus greatly influencing the accuracy of final results.

Second, as for model construction of emergency management evaluation, the existing model failed to scientifically measure variables, and scholars' collecting data didn't be tested on credibility and validity, so the scientificity and reasonability are to be discussed in spite of measuring by questionnaires. Besides, it's hard to ensure the preciseness of the conclusion for single-method model without verification and modification.

Third, for the determination of index weight, any scholars can decide the weight by means of AHP, but there exist two problems in its application such as

uncertainty of interplay between two indexes based on different principles criteria and differences in judging the matrix construction. For the former, a lot of data need to be analyzed their internal connection and for the latter, consulting specialists in the field can be helpful.

2.4.1 Necessity and Significance of Campus Emergency Management Capability Evaluation

1) Theoretical Significance

Evaluation on campus emergency management capability is to master the basic situation of campus emergency management and find out the existing problems and shortcomings of campus emergency management to provide scientific basis for related decisions of campus and supervision department.

2) Campus

Campus emergency management capability evaluation is comprehensive and systematic index evaluation. It can scientifically analyze the performance of campus emergency management capability in each stage, link and index of emergency management in the evaluation process and can also help campus improve and enhance emergency management in practice. Thompson (2008) also points out that campus can find out its own “short board” in the work through emergency management capability evaluation and will effectively improve campus emergency management capability with constant practice. Buckets Effect in management holds that comprehensive capability is decided by weakness instead of strength. Therefore, finding out “short board” and taking

relevant measures is the best way to improve the comprehensive capability of campus emergency management.

3) Education Authorities

Study on campus emergency management capability evaluation helps education authorities make a scientific evaluation of campus emergency management capability and level, master the actual conditions of campus emergency management and pertinently take corresponding policies and measures to actively promote and facilitate the healthy development of campus emergency management.

2.5 Summary

The literature review mainly does exploration in four aspects, campus emergency, campus emergency management, campus emergency management capability and campus emergency management evaluation. Through literature review, it can be clearly found that scholars have made many researches on campus emergency, campus emergency management, campus emergency management capability and campus emergency management evaluation, but they are still inadequate as a whole.

1) There is no definite and unitary concept definition on campus emergency. The classifications of campus emergency are too numerous, jumbled and irrelevant.

2) Analysis of campus emergency management capability is mainly based on management processor management function, contents are too single, and so it can not completely reflect contents of campus emergency management capability.

3) In campus emergency management capability evaluation, there are some models which have not scientifically measured variables in models. Though some scholars use methods such as questionnaire survey to measure indexes, data collected have not passed reliability and validity test.

4) The available evaluation models are mainly set up by single-method. They have not been validated and amended, so it is difficult to ensure the accuracy of conclusions.

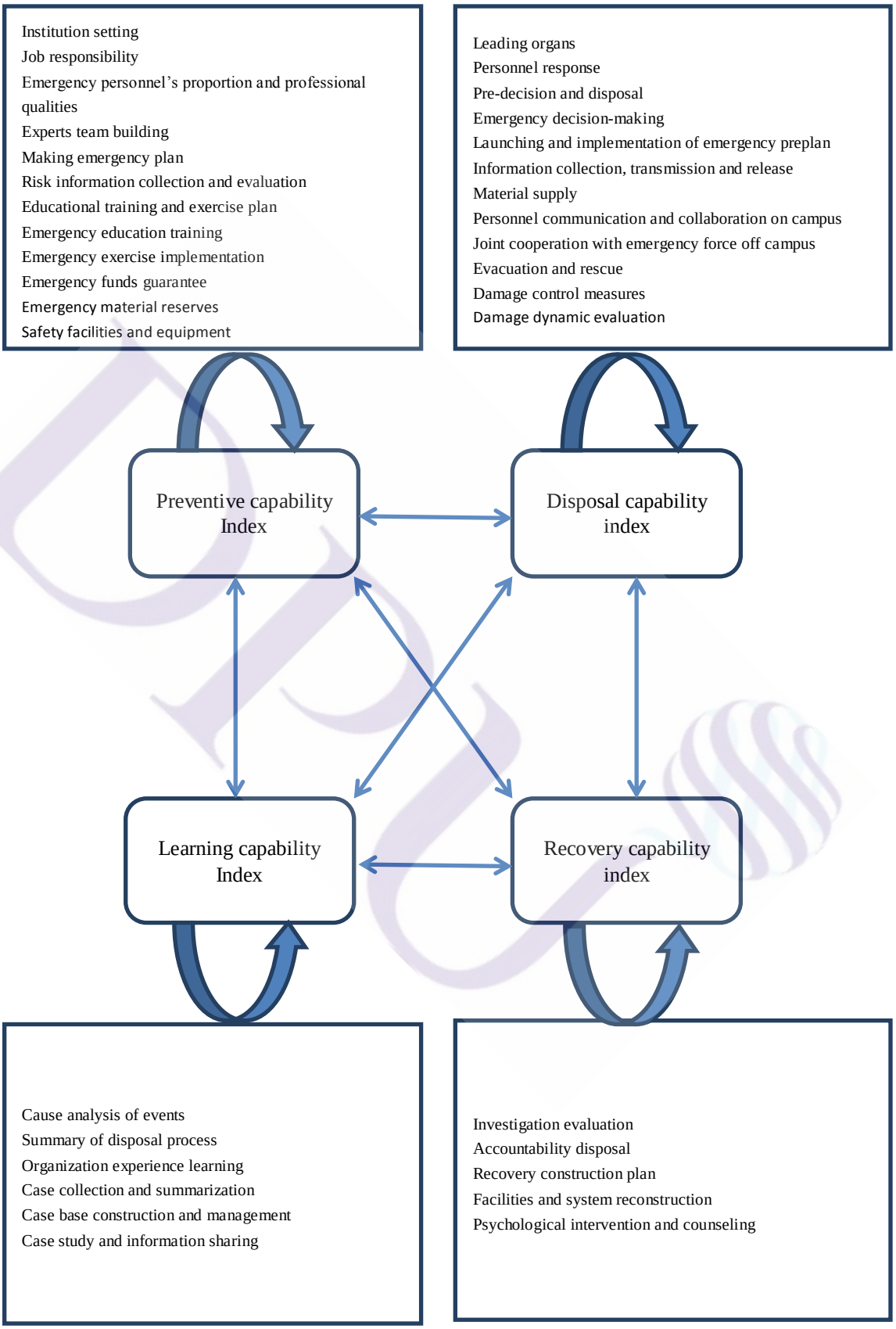
In view of this, this part begins with the concept and types of campus emergencies' and then focuses on the internal mechanism study as the basis to explore campus emergency management capability, for scientific selection of emergency management capability evaluation index and logical framework of emergency management capability evaluation system are set up according to basic analysis and reference of campus emergency management in America, Japan and Taiwan, as well as three dimensions like the management process, functions and capability formation elements.

CHAPTER 3

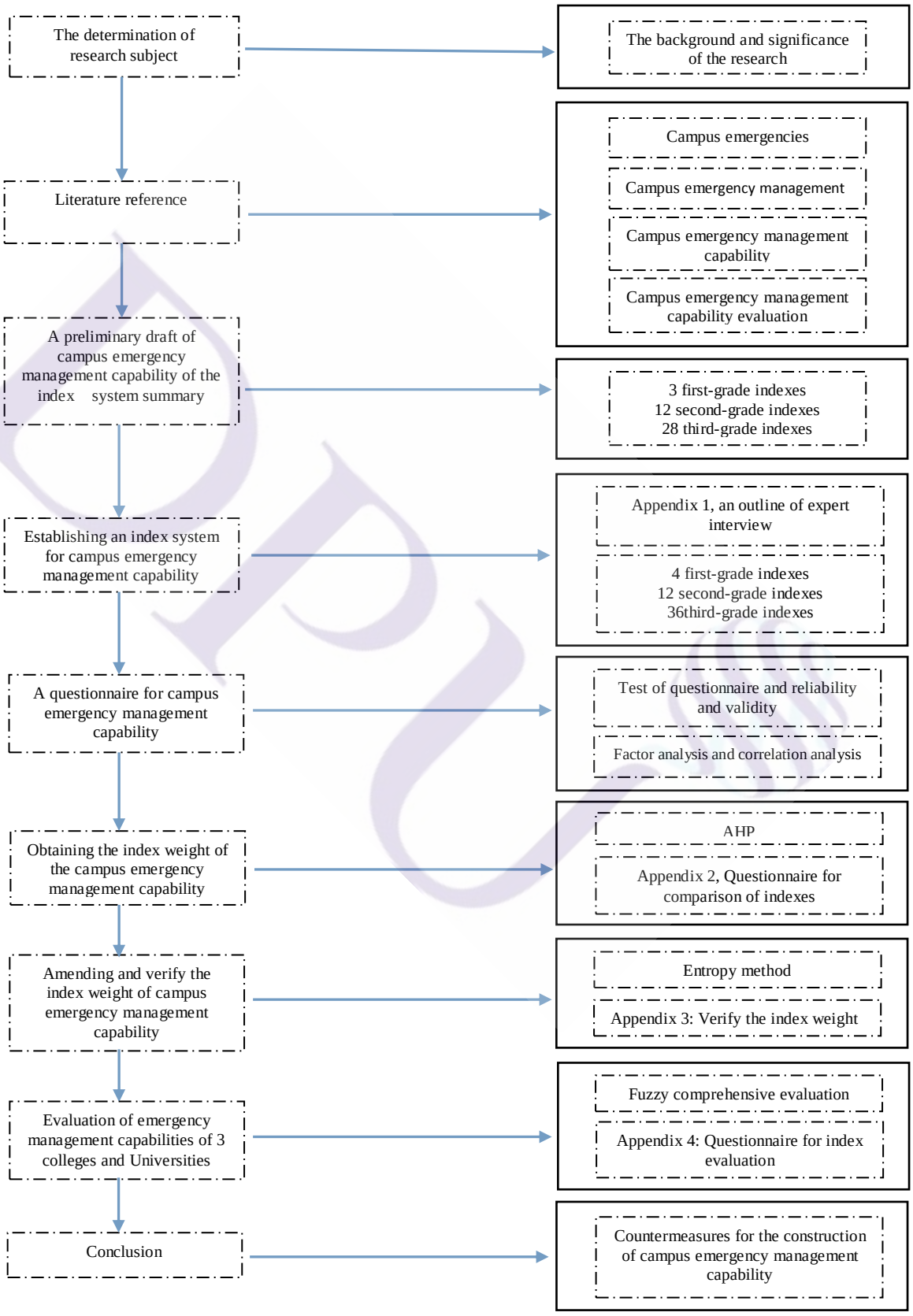
RESEARCH METHODS AND APPROACHES

3.1 Research Framework

The purpose of this research is to set up an index system for campus emergency management capability and explore the causes, influencing factors, weight proportion and effectiveness of each capability and index, so the research framework is illustrated below.


Institution setting
Job responsibility
Emergency personnel's proportion and professional qualities
Experts team building
Making emergency plan
Risk information collection and evaluation
Educational training and exercise plan
Emergency education training
Emergency exercise implementation
Emergency funds guarantee
Emergency material reserves
Safety facilities and equipment
Leading organs
Personnel response
Pre-decision and disposal
Emergency decision-making
Launching and implementation of emergency preplan
Information collection, transmission and release
Material supply
Personnel communication and collaboration on campus
Joint cooperation with emergency force off campus
Evacuation and rescue
Damage control measures
Damage dynamic evaluation
Preventive capability Index
Disposal capability index
Learning capability Index
Recovery capability index
Cause analysis of events
Summary of disposal process
Organization experience learning
Case collection and summarization
Case base construction and management
Case study and information sharing
Investigation evaluation
Accountability disposal
Recovery construction plan
Facilities and system reconstruction
Psychological intervention and counseling

3.2 Research Procedures



1) Using literature analysis to sort out and define the concept and connotation of emergency, emergency management, emergency management capability and campus emergency management capability.

2) Using comparative analysis to compare the differences of campus emergency management between China and other countries.

3) Using literature analysis to preliminarily summarize the campus emergency management capability evaluation index system.

4) Using experts interview to revise and perfect the campus emergency management capability evaluation index system.

5) Using AHP to calculate the weight of indexes at all levels.

6) Using Entropy Method to correct the comprehensive weight of each index.

7) Using a fuzzy comprehensive evaluation to establish a multi-level fuzzy comprehensive evaluation model and empirically test the model.

8) Making conclusions and prospects.

3.3 Research Approaches

This paper finishes its theoretical study of campus emergency management based on the literature analysis and combined with comparative analysis and comprehensive analysis. Therefore, the emergency management capability evaluation index system is preliminarily established. This paper further examines the scientificity and rationality of the design of campus emergency management capability index by expert forum to determine the index system. Using AHP, the evaluation index can be

divided into three levels and all index weights can be calculated. Then Entropy method is used to amend comprehensive weight value of indexes at all levels, thus building up a campus emergency management capability evaluation model based on multi-level fuzzy comprehensive evaluation. Through the case study, empirical analysis of the campus emergency management capability evaluation model is carried out, and the construction strategy of campus emergency management capability is put forward.

3.3.1 The Method of Expert Forum

Expert forum is a method of selecting a certain number of experts based on the prescribed principles and organizing a forum of experts in a certain way to bring an intelligent structure of root effect of expert group into play and make judgments on the future and condition of the trend of the forecast objects. Expert forum can help experts to exchange views and make up for the lack of personal opinions by mutual inspiration. What's more, through the internal and external information exchange and feedback, thinking resonance can be created and some creative thinking activities produced accordingly tend to focus on predicting objects to get creative and productive results in a relatively short period of time, thus providing basis for forecasting for the decision (Liu, 2012) .

In this study, an expert interview outline (see Appendix 1) is compiled according to the preliminary index design, whose purpose is to find out the problem and lay the foundation for the formal index design. The expert forum is expected to invite 30 experts who work on the emergency management for more than 10 years, including 80% of university experts, 10% of government experts and 10% of business experts, for

listening to their ideas and suggestions on the establishment of index system (See Table 3-1). Finally, according to the interview and survey results, the university emergency management capability evaluation index system is amended.

3.3.2 The Analytic Hierarchy Process

The analytic hierarchy process (abbr. AHP), is a systematic and hierarchical analysis method with the combination of qualitative and quantitative analysis, put forward by American operational research expert, T.L.Saaty in the mid-1970s. Huang, Wang and Wang (2012) point that the method is very practical and effective to solve complex decision-making problems, which can not only be applied in the situation where exists uncertainty and subjective information, but also allow judge subjects of a study by experience, insight and intuition in a logical way. Many indicators are involved in evaluating campus emergency management capability. If the AHP can be used to determine the weights of indexes, complex problems can be divided into individual factors. Then these factors are grouped according to the dominant relationship, forming a hierarchical structure, and the relative importance of every respective factors can be determined. Finally, the overall judgment gives a total ranking of the relative importance of decision-making problems.

According to the requirement of the nature and relationship of elements, the AHP is generally divided into four steps. First, the establishment of hierarchical structure model. Based on deep analysis of actual problems, the relevant factors are top-down decomposed into many levels according to different attributes, and the relationship among these factors is clearly expressed in the hierarchical structure in which the

elements in the same level subordinate to the upper level or have influence on the upper factors and at the same time dominate the next level or get influenced by lower factors. Second, construction judgment matrix. Starting from the second level of the hierarchical structure model, the judgment matrix is constructed by means of pairwise comparison in the factors that subordinate to (or influence) the upper layer, until the lowest level. The third is to calculate weight vector and do the consistency test. For each pair-wise comparison matrix, it is needed to calculate the largest eigenvalue and the corresponding eigenvector and conduct consistency test by using the random consistency index and the consistency ratio. If it is consistent with the requirements of consistency test, the normalized feature vector is the weight vector, and if not, it is needed to reconstruct the pair-wise comparison matrix. Fourth, calculating the combined weight vector and doing combination consistency test. This step is to calculate targeted combination vector in the lowest layer and do consistency check. If they meet the consistency test requirements, decisions can be made in accordance with the results showed by combination weight vector, otherwise it needs to reconsider the model or restructure a paired comparison matrix with lager consistency ratio.

The steps of how AHP determines the emergency capability evaluation index weight are as follows. First, the hierarchical analysis method is used to decompose the complex problems into various constituent factors, and the hierarchical structure is formed according to the subordinate relationship of indexes. Secondly, the questionnaire of index comparison (see Appendix 2) is filled out by experts to determine the relative importance of each index, and 30 experts who have been worked on emergency

management work for more than a decade are expected to do the questionnaire (80% of university experts, 10% of government experts, 10% of business experts. See Table 3-1) and score the relative importance of index. The judgment matrix is established based on the scores given by the experts and the basic principle of AHP. Finally, the weight vector of each index is calculated by the sum product method, and the consistency test can illustrate the logical rationality of the judgment matrix. It is worth noting that in using AHP method, consistency test is to test the importance of the coordination among factors, to avoid the contradiction that A is more important than B, B than C, and C than A. The normalization is to map the data within the range of 0 to 1, and the sum of processed data is equal to 1. Due to that the weight is the percentage of index importance, the weight of each index should is equal to 1.

Table 3-1 Expert Information Table for Index Comparison Questionnaire

Expert number	Work unit	Job / Rank	Working length(year)	Sector
G1	Municipal Public Security Bureau of Chongqing	Deputy inspector/ grade 3 police commissioner	23	government
G2	Chongqing Education Commission	Security director /chief level	19	government
G3	Chongqing Institute of University Security	Secretary General /chief level	15	government
B1	Chongqing Changzheng Heavy Industry Co., Ltd.	Security Minister / Senior Engineer	18	enterprise
B2	Chongqing Changan Group Co., Ltd.	Vice Minister of security / Engineer	14	enterprise
B3	Chongqing Construction Engineering Group Corporation Limited	Deputy General Manager / Senior Engineer	20	enterprise
U1	Chongqing University	Deputy Minister of	13	campus

Continued Table 3-1

Expert number	Work unit	Job / Rank	Working length(year)	Sector
		security department / Associate Professor		
U2	Chongqing University	Chief of the Department of defense / lecturer	21	campus
U3	Southwestern University	Deputy Minister of security department / Professor	17	campus
U4	Southwest University of Political Science & Law	Deputy Minister of security department /Associate Professor	14	campus
U5	Southwest University of Political Science & Law	Chief of the Department of defense / lecturer	11	campus
U6	Chongqing Jiaotong University	Director of the security service / Professor	22	campus
U7	Chongqing University of Technology	Deputy Minister of the security department / lecturer	12	campus
U8	Sichuan International Studies University	Deputy Minister of security department / Professor	22	campus
U9	Chongqing Normal University	Deputy Minister of security department /Associate Professor	15	campus
U10	Chongqing Technology and Business University	Chief of the Department of defense / lecturer	10	campus
U11	Sichuan Fine Arts Institute	Associate of security department /Associate Professor	16	campus
U12	Chongqing Police College	Vice President / Professor	25	campus
U13	Chongqing Police College	Deputy Minister of security Department/ Professor	19	campus
U14	Chongqing University of Posts and Telecommunications	Deputy Minister of security department / Associate Professor	15	campus
U15	Chongqing University	investigator of	23	campus

Continued Table 3-1

Expert number	Work unit	Job / Rank	Working length(year)	Sector
	of Science and Technology	Security department / Associate Professor		
U16	Chongqing University of Science and Technology	Chief of security department / Associate Professor	21	campus
U17	Chongqing Medical University	Minister of Defense / Professor	18	campus
U18	Chongqing Medical University	Chief of the Department of defense / lecturer	14	campus
U19	Chongqing College of Electronic Engineering	Deputy Minister / lecturer of the Department of security	17	campus
U20	Chongqing College of Electronic Engineering	Chief of the Department of defense / lecturer	11	campus
U21	Chongqing Aerospace Polytechnic	Minister of Defense / Vice Professor	18	campus
U22	Chongqing Industry Polytechnic College	Minister of Defense / Professor	17	campus
U23	Chongqing City Management College	Director of the security service /lecturer	10	campus
U24	Chongqing Youth Vocational & Technical College	Vice President / Associate Professor	19	campus

3.3.3 Entropy Method

Huang, Wang and Wang (2012) proposed that the expert scores in the AHP will inevitably lead to poor transitivity (transitivity is in logic and mathematics, if a, b, c are X, then the binary relationship R of the set X is transmitted. For example, “a” is related to “b”, and “b” to “c”, then “a” to “c”.) or have subjective standards, etc. In order to keep campus emergency management capacity index more objective and reliable and

have more research value, it is necessary to use the Entropy method to amend the weight calculated by the AHP. The Entropy method is a kind of objective weighting method, which can deeply reflect the utility value of index information entropy to determine the weight. Therefore, the index weight drawn by it has higher reliability and accuracy than subjective weighting method.

The Entropy method is a research method put forward by German physicist Clausius. It is a kind of objective weighting method with which the index is determined by calculating the information entropy. According to the influence that relevant changes have on the whole system, the index that has larger relative degree of change has a greater weight. This method is widely used in various fields such as statistics, with great research value. In term of information theory, entropy is a measure of uncertainty. The greater the amount of information is, the smaller the uncertainty becomes and also the smaller the entropy is, otherwise it goes to the opposite. According to the characteristics of entropy, the entropy can be used to determine the degree of randomness and disorder of an event, and the discretization of an index can be judged by the entropy. The greater the degree of index discretization is, the greater the effect of the index on the comprehensive evaluation (weight) is and meanwhile the smaller the entropy is. Using the Entropy method to do the comprehensive evaluation can deeply reflect the utility value of index information entropy, and can also reflect the combination of subjective and objective ideas, so that the evaluation system is more scientific and reasonable.

The Entropy method is generally divided into the following five steps. First, collecting the original data. According to the characteristics of research subject, relevant

data and information that the research needs shall be collected. Second, standardized data-processing. It means to standardize the index so as to eliminate the impact of the different dimensions on the evaluation results. Third, calculating information entropy and information utility value. The information value of indexes can directly affect the weight. So the greater the value of the information utility is, the greater the importance of the evaluation and the greater the weight are. The fourth is to calculate the weight of evaluation index, whose essence is using the value coefficient of index information to measure the importance of the evaluation. The higher the value coefficient is, the greater the importance of evaluation becomes. The final step is calculating the samples' evaluation values that are achieved by adopting weighted sum formula. The higher the value is, the better the sample effect is.

The steps of using the Entropy method to amend campus emergency management capacity index weight are as follows.

1) Collecting the data and constructing the judgment matrix

$$A=\begin{pmatrix} x_{11} & .. & x_{1m} \\ .. & .. & .. \\ x_{n1} & .. & x_{nm} \end{pmatrix}_{n\times m} \tag{3.1}$$

x_{ij} is the value of the jth index of the ith scheme.

2) Calculating the weight of the i scheme under item j p_{ij}

$$p_{ij}=\frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}} \qquad (i=1,2,...,n;\quad j=1,2,...,m) \tag{3.2}$$

3) Calculating the entropy of the jth indicator e_j

$$e_j=-k\sum_{i=1}^{n} p_{ij}\ln(p_{ij}) \tag{3.3}$$

including, $k > 0,\ \ k = 1/\ln(n),\ \ e_j \geq 0$

4) Calculating the difference coefficient of item j. The greater the difference between the index and the index value is, the greater the left and right of the program evaluation becomes, and the smaller the entropy is. The difference coefficient g_j

$$g_j = \frac{1 - e_j}{m - E_e} \tag{3.4}$$

including, $E_e = \sum_{j=1}^{m} e_j$

5) Calculating the weight coefficient of the evaluation index

$$\mu_j = \frac{g_j}{\sum_{j=1}^{m} g_j} \tag{3.5}$$

6) Using the Entropy method to calculate the weight coefficient μ_j, modifying the analytic hierarchy process to obtain the index weight coefficient ω_j, geting the objective index weight coefficient λ_j

$$\lambda_j = \frac{\mu_j \omega_j}{\sum_{j=1}^{n} \mu_j \omega_j} \tag{3.6}$$

The Entropy method is used to correct the weight coefficients of each level index.

3.3.4 Fuzzy Comprehensive Evaluation Method

A single evaluation evaluates a factor or a part of an object or a category based on a defined criterion. A comprehensive evaluation evaluates an overall evaluation of a particular object or category by many single evaluations. There are a lot of blurring in the

objective world. Because of the complexity of the system faced by modern science and technology, ambiguity is always accompanied by the emergence of complexity, and especially the humanities, social sciences and other "soft science" requires more ambiguous mathematical processing. For example, social systems have many parameters and variables which are intertwined, and the system is very complex, so its ambiguity is also very obvious. Another example is the words "young, beautiful", etc., for there is no clear quantitative boundaries, and some vague words are needed to describe, not a simple yes or no or numbers.

Chen (2014) has mentioned that the evaluation of things from many aspects is inevitably accompanied by ambiguity and subjectivity, but the use of "fuzzy transformation principle" in the fuzzy mathematics can have a comprehensive consideration of things so as to keep the results as objective as possible, thus achieving better practical results. Fuzzy comprehensive evaluation originated from the fuzzy set theory, a research method put forward by the United States Professor L.A.Zadeh in 1965 in the "Fuzzy Sets" article. In the fuzzy set, the membership of it is not necessarily "yes" or "no" in a given range, but with a real number between 0 and 1 to represent the degree of membership, there is also an intermediate transition status. This method is based on the theory of membership degree of fuzzy mathematics, and the problem of qualitative evaluation and analysis is transformed into quantitative evaluation and analysis. It is based on the principle of fuzzy mathematics to make an overall evaluation of the objects or things with many factors and non-conceptual boundaries. Fuzzy comprehensive evaluation method characterized by having clear results and strong systematicness, can

solve those problems that are fuzzy and difficult to quantify, and it also can be applied to a variety of non-linear or fuzzy issues. Fuzzy comprehensive evaluation method evaluates the various factors separately by using the single factor evaluation, and then acquires the comprehensive evaluation based on the results of the single factor evaluation, so as to obtain the final evaluation.

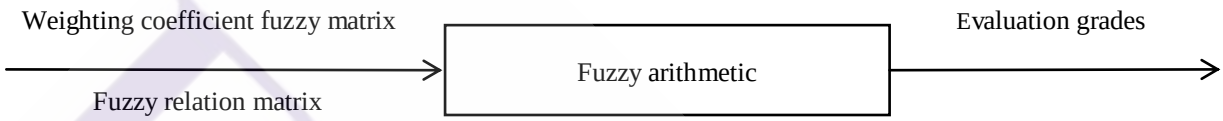


Figure 3-1 The Principle of Fuzzy Mathematics

Campus emergency management capacity evaluation involves a lot of indexes, and the importance of the index is different, causing relevant problems complicated. It would be very difficult to use the classical mathematical methods to solve the comprehensive evaluation. In addition, if the index is put into one level of evaluation, the weight of each index obtained after the normalization of the weight is very small, and indexes that do not belong to the same level are compared together, which do not have a comparative value. Therefore, this paper uses the three-level fuzzy comprehensive evaluation to evaluate campus emergency management capability, and can obtain the quantitative comprehensive evaluation results, and provide the decision basis for improving the emergency management capability of colleges and universities.

Fuzzy comprehensive evaluation is based on the certain weight to establish fuzzy evaluation set, and the fuzzy comprehensive evaluation steps of campus emergency management capability are as follows.

1) Set up Index Set $U = (U_1, U_2, ..., U_n)$

2) Determine the evaluation set $V=(V_1,V_2,...,V_m)$

M is generally odd in many situations, and the collection is symmetrical, such as "excellent, good, average, pass, fail", so the comprehensive evaluation results make it easier to be used in the following calculation.

3) Identify the index weight vector W

Let vector W be the membership function of all indexes in the set U to the evaluated object, that is the weight subset of U, $W=(W_1,W_2,...,W_3)$

4) Quantitative evaluation set

To understand the situation of all indexes through the questionnaire survey. Quantification is generally used percentage system, which stipulates that the value between 90 to 100 points means excellent, 80 to 90 good, 70 to 80 average, 60 to 70 pass, and below 60 points fail.

5) Set up fuzzy relation matrix

$$R=\begin{pmatrix} R_1 \\ R_2 \\ ... \\ R_n \end{pmatrix}=\begin{pmatrix} r_{11} & r_{12} & .. & r_{1m} \\ r_{21} & r_{22} & .. & r_{2m} \\ .. & .. & .. & .. \\ r_{n1} & r_{n2} & .. & r_{nm} \end{pmatrix}$$

Among them, R_n--the N^{th} the evaluated index, r_{ij}--the degree of membership of each grade in V by R_n, that means from the i^{th} factor to make the possibility of the j^{th} evaluation, n--the number of be evaluated index, m--the number of evaluation grades.

6) Taking comprehensive evaluation

The fuzzy comprehensive evaluation relation is established $B=W\circ R=\begin{pmatrix} b_1 & b_2 & .. & b_n \end{pmatrix}$, then the fuzzy subset of the evaluation set can be worked

out $B = (b_1 \quad b_2 \quad .. \quad b_n)$, " $\circ$ " is the fuzzy operator.

The basic principle of a fuzzy comprehensive evaluation problem is, through fuzzy relation, to convert a fuzzy set W on the universe of evaluation factors set U into a fuzzy set B on the universe of evaluation set V.

3.4 Questionnaire Description

In this part, the design of the questionnaire is introduced in detail under the premise of clearly putting forward the principle of experts' selection.

3.4.1 Selection Principle of Experts

1) The universality of expert sources. The invited experts should come from different units of the system, because thinking set from a similar unit or department can be easily formed. And it is more inclined to make judgments beneficial to their own unit development, group interests and departmental interests during the judging process, due to their subjective judgments and individual specific work unit. In order to eliminate the situation of similar or extreme scores which caused by experts from similar units, we should select experts from different units of the system, and pay more attention to the balance and coordination of the system and departments these experts are in. Therefore, different proportions of experts from universities, government and enterprises are selected in this study.

2) The fairness of expert attitude. Experts should uphold the fair and just attitude in judging process, so that the matrix can be valuable. Although the universality of expert sources can ensure fairness at some extent in the selection process,

we should also avoid those experts who have academic misconduct and radical thinking, ensuring that these experts are familiar with scoring rules and process before make a judgment. Fairness is very important, and if the expert did not judging objectively, it may cause data distortion.

3) The rationality of the composition of experts. It refers to the reasonable distribution of experts in the academic field and age structure. If all of their academic fields focus on one area like emergency response, the judgments from experts in this field have higher credibility on the emergency response factors, but lower credibility on other academic fields. The rational distribution of age structure can avoid thinking set, and its intercrossing distribution can make experts' knowledge and views complement each other, so as to get a more reasonable judgment. Thus, a reasonable age structure of experts contributes to the impartiality of the results.

4) The academic prestige of experts. It mainly refers to the experts who achieve certain results in a research field with extensive specialized knowledge, solid basic knowledge and own a certain reputation in the academic field. The prestigious experts are more comprehensive and credible in the analysis of the problem. Therefore, we try to choose the authoritative experts in the field of academic research (Liu, 2016).

In summary, based on the principle of expert selection, we invite 30 experts who have worked on the emergency management for more than 10 years in this study, with 80% of university experts, 10% of government experts and 10% of business experts.

3.4.2 The Introduction of Questionnaire

It consists of two questionnaires, including the index comparison questionnaire

used to obtain the index weight, and the index evaluation questionnaire used to obtain the membership degree of the index.

3.4.2.1 Index Comparison Questionnaire

In the questionnaire (see Appendix 2), the main body consists of two parts. The first part is mainly collecting personal information, including gender, age, unit, education and other basic information. By analyzing the information, you can get an overall understanding of the basic situation of the questioned expert, and it is also conducive to make a preliminary judgment of the questionnaire's effectiveness. The second part is intended to use the AHP. According to the relationship of interaction effect and the subordinate among indexes, the hierarchy structure which can accurately evaluate the research object is established. Doing a survey on the experts by questionnaire means to compare with the indexes at the same level, ranking the index from 1-9 by its significance to construct the index judgment matrix at all levels.

3.4.2.2 Index Evaluation Questionnaire

In the questionnaire (see Appendix 4), the main body consists of two parts. The first part is mainly collecting personal information, including gender, age, unit, education and other basic information. By analyzing the information, you can get an overall understanding of the basic situation of the questioned expert, and it is also conducive to make a preliminary judgment of the questionnaire's effectiveness. The second part is intended to use fuzzy comprehensive evaluation method to determine the membership of the three-grade index, and use five-point scale to measure the variables, and that is 5-excellent, 4-good, 3-average, 2-pass, 1-fail. So it's good to use these scales

to evaluate the practical level of campus emergency management capability index.

3.5 The Inspect of Index Evaluation Questionnaire

This part mainly introduces the questionnaire pre-test and the results, and analyzes the reliability and validity of the questionnaire based on the data obtained from the prediction.

3.5.1 Pre-test

The research objects of small sample are the leaders of colleges and universities, the leaders and staff of emergency management departments. In this small sample survey, 100 questionnaires were distributed, 100 questionnaires were collected, and 83 valid questionnaires were selected out through removing the invalid questionnaires with same scores. By analyzing the first part of the questionnaire, the respondent is concentrated at the age of 28-50. Because the selected objects are college staff, 85% of the education is higher than master degree.

Due to small sample and the advantage of the convenience of author's identity, the research samples are much easier to find. In the questionnaire survey, the Leaving Method method is adopted (it refers that questionnaires are left to respondents and corresponding requirements of filling are also given some explanations. When the respondents fill out by their own, then questionnaires can be regularly returned to investigators). This method can effectively avoid data distortion with the interaction of respondents.

3.5.2 Reliability and Validity Analysis

Reliability analysis involves the consistency and stability of the questionnaire results and is usually used to remove the meaningless measurement items of variables measuring, so as to improve the reliability of each measure variable. The final purpose is to control and reduce random errors. The reliability analysis itself has nothing to do with the correctness of measurement results, because it is aimed to test whether the measurement itself is stable. The validity is the mirror of effectiveness and correctness of the questionnaire. The higher validity values is, the higher authenticity of the tested behavior is, so that the purpose of the questionnaire test can be achieved as soon as possible, and the correctness and effectiveness of the questionnaire can also be guaranteed (Lv, 2014). In this study, the reliability and validity are tested by SPSS software.

3.5.2.1 Reliability Analysis

In order to ensure the reliability of the questionnaire, the following points are made in the process of questionnaire design and implementation. First, questionnaires are as few as possible, and there are only 36 subjects of the main body. Second, the language is easy to understand and simple, and the five-point scale scoring method is adopted in the main part. The third is the anonymous filling of the questionnaire. The fourth is requiring the respondents to take and fill the questionnaire separately.

Cronbach's α coefficient method can be used to test the reliability of the measurement items. The coefficient value of α lies between 0 and 1, so the higher value is, the higher α becomes, the higher the reliability is, and the better the internal consistency of the questionnaire is (Cronbach, 1963). The reliability test results of the

survey data are as follows.

Table 3-2 Questionnaire Survey Reliability Test

Dimension	Cronbach's Alpha	Number of terms
Preventive capability A1	.807	13
Organizational structure B1	.846	4
Information early-warning B2	.812	3
Educational training and drill B3	.893	3
Funds, materials and facilities B4	.798	3
Disposal capability A2	.821	12
Emergency organizing B5	.785	2
Emergency commanding B6	.856	3
Emergency coordinating B7	.834	4
Emergency controllingB8	.802	3
Recovery capability A3	.876	5
Post-emergency disposal B9	.903	2
Recovery construction B10	.874	3
Learning capability A4	.852	6
Case study B11	.881	3
Case base study B12	.847	3
Campus emergency management capability	.835	36

From the analysis results, α coefficient is 0.835 with relatively high reliability, so that it can be seen that the reliability of the data meet the analysis requirements.

3.5.2.2 Validity Analysis

The questionnaire of this study is based on a large number of literatures about the campus emergency management capability, and it combines the comparative analysis of the practical capability of emergency management in universities and colleges in different countries and regions (management system, emergency capability factors, etc.), and takes the particularity of campus emergency management into consideration. In the

preparation, we first formulate and revise the basic content of the investigation outline and then make final decision based on expert's advice to ensure the comprehensiveness of the content on the whole structure and avoid important omissions. And the second is to prepare the questionnaire's content according to the list one by one to achieve the concept operation, which is, converting abstract concepts into observable concrete indicators or topics. Then, the content validity and construct validity of the questionnaire are both tested by factor analysis and correlation analysis.

1) Data analysis methods

A. Factor analysis

Factor analysis starts from the dependency inside the research variables, and it comes up some perplexing variables to a multivariable statistical analysis method of several comprehensive factors. The basic idea is to classify the observed variables and put the high correlation variables, which is more closely linked, into the same class. Some results show that the correlation between different variables is low, so each variable actually represents a basic structure, namely the common factor. The issue studied is to describe each component of the original observations with the sum of the linear functions of the least number of unpredictable common factors as well as the sum of special factors. The information is filtered by factor analysis in two ways. On one hand, it can filter false information, thus reducing the impact of independent index, which means that the factor analysis just can eliminate the "noise" of the interference. On the other hand, factor analysis maybe miss information during the reduced data and dimensionality reduction process. Therefore, in the study of multidimensional and

complex system through using factor analysis, it is necessary to give an objective and reasonable conclusion by combining the classification with professional knowledge. (Liu, Wang & Jin, 2009).

When using the factor analysis method, we should take the KMO and the Bartlett Sphere test to determine whether the variables are suitable for the factor analysis. The principal component analysis and the limited axis method are adopted to construct the factor variables, and the VariMax method is used to orthogonal rotate the factor matrix. KMO test and Bartlett Sphere test results show that, the value ranges from 0~1 and 0.9~1 stands for excellent, 0.8~0.9 for feasible, 0.7~0.8 for better, 0.6~0.7 for average, 0.5~0.6 for bad, and 0~0.5 for unacceptable. The probability of coincidence of Bartlett sphericity test should be less than 0.01, which means that the correlation coefficient matrix is not a unit matrix, so it is suitable for factor analysis (Lv, 2014).

B. Correlation analysis

Correlation analysis refers to the analysis of the variables with two or more correlations and the two variables' relative correlation. This paper mainly adopts linear correlation analysis to study the degree of linear relation between two variables. The correlation coefficient is a statistic which describes the degree and direction of the linear relation and is expressed as r (Liu, Wang, & Jin, 2009).

If there is a functional correlation between variable Y and X, then r=1, or r=-1. If they are in statistical correlation, then $-1<r<1$, and r=0 means no linear correlation. In general, $|r|>0.95$ stands for a significant correlation, $|r|>0.8$ means high correlation, $0.5<|r|<0.8$ means to be moderately related, $0.3<|r|<0.5$ shows low correlation, $|r| <0.3$

indicates weak correlation and even no correlation (Lv, 2014).

2) Construct validity

A. Preventive capability index

According to the survey items in the questionnaire, the analysis and description statistics are as follows.

Table 3-3 Descriptive Statistics n=83

	Mean	Std Deviation
C1	4.542	.588
C2	4.708	.464
C3	4.542	.588
C4	3.958	.751
C5	4.125	.741
C6	4.000	.722
C7	4.000	.885
C8	4.333	.702
C9	3.917	.929
C10	3.917	.881
C11	3.917	.974
C12	4.000	.885
C13	3.833	.963

The result of KMO and Bartlett's Test of Sphericity

Table 3-4 KMO and Bartlett's Test

KMO Measure of Sampling Adequacy.		.730
Bartlett's Test of Sphericity	Approx.Chi-Square	136.731
	Df	78
	Sig	.000

The KMO value is 0.730, more than 0.7, which indicates that there is no big difference in the correlation between variables, so it can be considered suitable for factor

analysis. The probability of Bartlett test sphericity is less than 0.01, which indicates that the correlation coefficient matrix is not a unit matrix, so it is suitable for factor analysis.

Table 3-5 Total Variance Explained

Component	Factor Loadings			
	Organizational structure B1	Information early-warning B2	Educational training and drill B3	Funds, materials and facilities B4
C1	.862			
C2	.706			
C3	.782			
C4	.613			
C5		.722		
C6		.809		
C7		.757		
C8			.705	
C9			.818	
C10			.743	
C11				.727
C12				.694
C13				.782
Eigenvalues	6.841	1.233	1.115	1.032
% variance	52.623	9.485	8.577	7.938

As shown in Table 3-5 above, the factor loadings are all above 0.5, consistent with the construct validity requirements of the questionnaire and suitable for the analysis of the overall interpretive degree of the variables for each factor. Generally, in social science, when the proposed variables' interpretive degree of researched factors is more than 30%, these variables can be considered valid.

B. Disposal capability index

According to the survey items in the questionnaire, the analysis and description statistics are as follows.

Table 3-6 Descriptive Statistics n=83

	Mean	Std Deviation
C14	4.125	.797
C15	4.917	.282
C16	4.833	.381
C17	4.708	.464
C18	4.792	.415
C19	4.833	.381
C20	3.917	1.018
C21	4.583	.584
C22	4.417	.717
C23	4.833	.381
C24	4.375	.647
C25	3.500	.933

The result of KMO and Bartlett's Test of Sphericity

Table 3-7 KMO and Bartlett's Test

KMO Measure of Sampling Adequacy.		.715
Bartlett's Test of Sphericity	Approx.Chi-Square	65.930
	Df	66
	Sig.	.000

The KMO value is 0.715, more than 0.7, which indicates that there is no big difference in the correlation between variables, so it can be considered suitable for factor analysis. The probability of Bartlett test of sphericity is less than 0.01, which indicates that the correlation coefficient matrix is not a unit matrix, so it is suitable for factor analysis.

Table 3-8 Total Variance Explained

Component	Factor Loadings			
	Emergency organization B5	Emergency commanding B6	Emergency coordination B7	Emergency control B8
C14	.915			
C15	.784			
C16		.884		
C17		.784		
C18		.817		
C19			.791	
C20			.698	
C21			.745	
C22			.651	
C23				.902
C24				.837
C25				.796
Eigenvalues	6.171	1.042	1.009	1.122
% variance	51.425	8.683	8.408	9.350

As shown in Table 3-8 above, the factor loadings are all above 0.5, consistent with the construct validity requirements of the questionnaire and suitable for the analysis of overall interpretive degree of the variables for each factor.

C. Recovery capability index

According to the survey items in the questionnaire, the analysis and description statistics are as follows.

Table 3-9 Descriptive Statistics n=83

	Mean	Std Deviation
C26	3.917	1.018
C27	3.875	1.116
C28	4.125	.992
C29	4.208	.779
C30	4.083	.776

The result of KMO and Bartlett's Test of Sphericity

Table 3-10 KMO and Bartlett's Test

KMO Measure of Sampling Adequacy.		.693
Bartlett's Test of Sphericity	Approx.Chi-Square	22.945
	Df	10
	Sig.	.000

The KMO value is 0.693, approximately equal to 0.7, which indicates that there is no big difference in the correlation between variables, so it can be considered suitable for factor analysis. The probability of Bartlett test sphericity is less than 0.01, which shows that the correlation coefficient matrix is not a unit matrix, so it is suitable for factor analysis.

Table 3-11 Total Variance Explained

Component	Factor Loadings	
	Post-emergency disposal B9	Recovery construction B10
C26	.871	
C27	.743	
C29		.842
C30		.793
C28		.708

Continued Table 3-11

Component	Factor Loadings	
	Post-emergency disposal B9	Recovery construction B10
Eigenvalues	2.564	1.032
% variance	51.280	20.460

As shown in Table 3-11 above, the factor loadings are all above 0.5, consistent with the construct validity requirements of the questionnaire and suitable for the analysis of the overall interpretive degree of the variables for each factor.

D. Learning capability index

According to the survey items in the questionnaire, the analysis and description statistics are as follows.

Table 3-12 Descriptive Statistics n=83

	Mean	Std Deviation
C31	4.208	.833
C32	4.208	.779
C33	3.958	.807
C34	4.208	.779
C35	4.292	.751
C36	4.125	.680

The result of KMO and Bartlett's Test of Sphericity

Table 3-13 KMO and Bartlett's Test

KMO Measure of Sampling Adequacy.		.801
Bartlett's Test of Sphericity	Approx.Chi-Square	103.567
	Df	15
	Sig.	.000

The KMO value is 0.801, more than 0.7, which indicates that there is no big

difference in the correlation between variables, so it can be considered suitable for factor analysis. The probability of Bartlett test sphericity is less than 0.01, which indicates that the correlation coefficient matrix is not a unit matrix, so it is suitable for factor analysis.

Table 3-14 Total Variance Explained

Component	Factor Loadings	
	Case study B11	Case base study B12
C31	0.761	
C32	0.684	
C33	0.811	
C34		0.741
C35		0.627
C36		0.839
Eigenvalues	1.281	3.162
% variance	21.350	52.700

As shown in Table 3-14 above, the factor loadings are all above 0.5, consistent with the construct validity requirements of the questionnaire and suitable for the analysis of the overall interpretive degree of the variables for each factor.

3) Correlation coefficient

A. Preventive capability index

For the preventive capability indexes, the correlation between them can be seen in the table below according to the survey items in the questionnaire for Pearson Correlation test.

Table 3-15 The Correlation Between Preventive Capability Indexes

	C1	.1 C2	9 2 C3*	5 C4	.0 C5	. C6	- C7	- C8	-.C9	C10	1 C11	C12	1 C13
C1	1												
C2	.126	1	.444*	-.036	.237	.130	.106	.445*	.244	.044	-.152	.106	-.308
C3	.497*	.444*	1	-.045	.436*	.409*	.167	.386	.086	.175	-.145	-.167	-.294
C4	.152	-.036	-.045	1	.479*	.321	.327	-.055	.182	.126	-.421*	-.065	.050
C5	.037	.237	.436*	.479*	1	.431**	.331**	.385**	.395	.417*	-.166	-.066	-.152
C6	.000	.130	.409*	.321	.431**	1	.445**	.480**	.130	.484**	-.247	-.272	.063
C7	-.167	.106	.167	.327	.331**	.445**	1	.350	.318	.437**	-.353	-.167	-.051
C8	-.035	.445*	.386	-.055	.385**	.480**	.350	1	.311	.469*	-.148	.000	-.171
C9	-.232	.244	.086	.182	.395	.130	.318	.311	1	.257	-.200	.159	-.405*
C10	-.161	.044	.175	.126	.417*	.484**	.437**	.469*	.257	1	-.313	-.335	-.017
C11	-.145	-.152	-.145	-.421*	-.166	-.247	-.353	-.148	-.200	-.313	1	.101	-.154
C12	-.167	.106	-.167	-.065	-.066	-.272	-.167	.000	.159	-.335	.101	1	.102
C13	.013	-.308	-.294	.050	-.152	.063	-.051	-.171	-.405*	-.017	-.154	.102	1

* In the level 0.05(two-tail),the correlation is significant. **In the level 0.01(two-tail),the correlation is significant.

Since |r|<0.5 is lowly correlated or irrelevant. As can be seen from the above table, the correlation between the indexes of disposal capability is lower than 0.5, indicating that the correlation between them is very weak.

B. Disposal capability index

For the disposal capability indexes, the correlation between them can be seen in the table below according to the survey items in the questionnaire for Pearson correlation test.

Table 3-16 The Correlation Between Disposal Capability Indexes

	C14	.07C152	.C16	..C17	. C18	C19	C20	C21	.2 C2209	.07 C232	C242	80 C25
C14	1											
C15	.048	1	-.135	.138	-.155	-.135	.126	.308	-.036	-.135	.179	.330
C16	.072	-.135	1	-.041	-.229	-.200	-.037	.065	-.053	-.200	-.441*	.000
C17	.220	.138	-.041	1	-.329	-.287	-.238	.174	.120	-.041	.235	.151
C18	-.049	-.155	-.229	-.329	1	-.229	-.043	-.374	.158	.046	.142	-.281
C19	.072	-.135	-.200	-.287	-.229	1	.075	-.326	.106	.100	-.265	.000
C20	-.147	.126	-.037	-.238	-.043	.075	1	.012	-.248	-.150	-.017	-.046
C21	.117	.308	.065	.174	-.374	-.326	.012	1	-.498*	-.326	.317	.399
C22	.209	-.036	-.053	.120	.158	.106	-.248	-.502*	1	-.053	.023	-.195
C23	.072	-.135	-.200	-.041	.046	.100	-.150	-.326	-.053	1	-.265	-.122
C24	.074	.179	-.441*	.235	.142	-.265	-.017	.317	.023	-.265	1	.252
C25	.380	.330	.000	.151	-.281	.000	-.046	.399	-.195	-.122	.252	1

* In the level 0.05(two-tail), the correlation is significant. ** In the level 0.01(two-tail), the correlation is significant.

As can be seen from the above table, the correlation between the indexes of disposal capability is lower than 0.5, indicating that the correlation between them is very weak.

C. Recovery capability

For the learning capability indexes, the correlation between them can be seen in the table below according to the survey items in the questionnaire for Pearson correlation test.

Table 3-17 The Correlation Between Recovery Capability Indexes

	C26	-.C27	-.C28	. C29	4 C3086*
C26	1				
C27	-.201	1	-.142	.131	.264
C28	-.118	-.142	1	.246	.155
C29	-.032	.131	.246	1	.418**
C30	-.486*	.264	.155	.418**	1

* In the level 0.05(two-tail), the correlation is significant. **In the level 0.01(two-tail), the correlation is significant.

As can be seen from the above table, the correlation between the indexes of recovery capability is lower than 0.5, indicating that the correlation between them is very weak.

D. Learning capability index

For the learning capability indexes, the correlation between them can be seen in the table below according to the survey items in the questionnaire for Pearson correlation test.

Table 3-18 The Correlation Between Learning Capability Indexes

	C31	.C32	.1 C33	. C34*	.20 C35*	37 C36*
C31	1					
C32	.400**	1	.399*	.270**	.284**	.170**
C33	.196**	.399*	1	.037**	.252*	.365**
C34	.234**	.270**	.037**	1	.235**	.170**
C35	.203**	.284**	.252*	.235**	1	.178**
C36	.397**	.170**	.365**	.170**	.178**	1

* In the level 0.05(two-tail), the correlation is significant. **In the level 0.01(two-tail), the correlation is significant.

As can be seen from the above table, the correlation between the indexes of

learning capability is lower than 0.5, indicating that the correlation between them is very weak.

To sum up, all the indexes meet the requirements of further investigation and research through the reliability and validity test.

3.6 Summary

This section elaborates the research framework, procedures, methods, questionnaires and so on. It focuses on research methods, using expert forum to screen and amend campus emergency management capacity evaluation index. Then AHP method is used to determine the index weight at all levels according to the survey data in index comparison, and the Entropy method is used to modify the weight. In this chapter, questionnaires are made for index evaluation and analysis of reliability and validity and meanwhile the fuzzy comprehensive evaluation method is applied to empirically analyze campus emergency management capacity.

CHAPTER 4

CAMPUS EMERGENCY MANAGEMENT CAPABILITY EVALUATION

4.1 Establishing An Index System for Campus Emergency Management Capability

According to the preliminary index design, the expert forum is firstly used to screen and amend evaluation index. Finally, the emergency management index system including 4 first-grade indexes, 12 second-grade indexes and 36 three-grade indexes is determined.

4.1.1 The Selection of Evaluation Index

In order to guarantee the scientificity and applicability of evaluation index system, the selection of each index should be in accordance with definite procedures and principles.

4.1.1.1 Selection Procedures

In order to guarantee the scientificity and applicability of evaluation index system, the selection of each index should be in accordance with definite procedures, and the determination of evaluation index needs to take many factors into consideration, then we can establish a complete, scientific and reasonable evaluation index system which ensures objective and appropriate evaluation on the objects.

First, we should form an integral structural frame based on the frame of campus emergency management and combined with the previous studies and suggestions.

Next, it refers to construction conditions of campus evaluation index system. By combining actual conditions of researches, filtering and verifying evaluation indexes, a factor system that have influence on campus emergency management capability is formed to guarantee the completeness of index sources according to experts' suggestions.

Finally, based on the above studies, it needs to reasonably select influencing factors in the system, eliminate inappropriate index or non-representative factors and reserve appropriate evaluation index factors to finally form a campus safety emergency management capability evaluation index system.

4.1.1.2 Selection Principles

1) Practical principle. The involved index system should be simple and practical. Data should mainly come from different types of statistical indexes. When statistical data are not good for collection, experts can make an evaluation according to actual conditions.

2) Independence principle. There are many factors that exert effects on campus emergency management capability. We should eliminate the compatibility among indexes in indicator system and avoid the phenomenon of repeatedly setting up index which may distort the evaluation results.

3) Guidance principle. The purpose of establishing campus emergency management capability evaluation index system is to standardize campus

emergency capability so that it can direct campus emergency capability construction. That is to say, selection of the index must be beneficial for improving campus emergency management capability.

4.1.2 Preliminary Design for Evaluation Index System

The index system plays an extremely important role in the evaluation while a comprehensive and scientific evaluation index system is the key to successful evaluation. All evaluation programs and factors in campus emergency management capability evaluation index system are all displayed through specific index. When selecting evaluation index at all grades, we should analyze every specific index that reflects influencing factors of campus emergency management capability to determine the correlation of campus emergency management capability evaluation, and finally establish a campus emergency management capability evaluation index system. Therefore, the thesis pays much attention to index system establishment and does lots of researches.

According to the summary of expert feedbacks, it indicates that campus emergency management is a dynamic and circular process based on "prevention in advance", "disposal in the emergency" and "recovery afterwards". So campus emergency management capability evaluation also should be a dynamic and circular process. That is to say, it should evaluate campus emergency preventive capability, disposal capability in-emergency and recovery capability post-emergency to achieve the evaluation of campus emergency management capability and make improvement and perfection to gradually improve campus emergency management capability. On the basis of researches on the content of emergency management capability, some efforts are made to integrate

the analysis of management function dimension and capability factors into four processes of management to comprehensively analyze all factors of campus emergency management capability as far as possible and then work out preliminary design of indicator system, as shown in Table 4-1.

Table 4-1 Campus Emergency Management Capability Evaluation Index System Draft

Evaluation Objects O	The first grade index A	The second grade index B	The third grade index C
Campus emergency management capability	Preventive capability Index A1	Organizational structure B1	Institution setting C1
			Job responsibility C2
			Emergency personnel's proportion and professional qualities C3
		Information early-warning B2	Making emergency plan C4
			Risk information collection and evaluation C5
			Early-warning implementation C6
		Education training and drill B3	Educational training and drill plan C7
			Emergency drill implementation C8
		Funds, materials and facilities B4	Emergency funds and materials C9
			Safety facilities and equipment C10
	Disposal capability index A2	Emergency organizing B5	Leading organs C11
			Personnel response C12
		Emergency commanding B6	Pre-decision and disposal C13
			Launching and implementation of emergency preplan C14
		Emergency coordinating B7	Information transmission C15
			Material supply C16
			Personnel communication and collaboration C17
		Emergency controlling B8	Evacuation and rescue C18
			Isolation measures C19
			Damage evaluation C20
	Recovery of	Post-emergency	Investigation evaluation C21

Continued Table 4-1

Evaluation Objects O	The first grade index A	The second grade index B	The third grade index C
	learning capability index A3	disposal B9	Responsibility disposal C22
		Recovery construction B10	Facilities and system reconstruction C23
			Psychological intervention and counseling C24
		Case study B11	Cause analysis of events C25
			Summary of disposal process C26
		Overall study B12	Case collection and arrangement C27
			Information learning and sharing C28

According to the preliminary index design, the expert interview outline (see Appendix 1) is compiled. The purpose is to find out the problem and lay the foundation for the formal index design.

4.1.3 Revision of Evaluation Index System

The selection of evaluation index is not only related to professional knowledge but also the means of access to information. Too many indexes may cause repeated investigation, thus affecting on the capability examination of campus emergency management. However, too few may also lead to the lack of comprehensiveness, so the evaluation results are not representative. In this study, the expert interview method is used to invite 12 experts to do interview, listening to their ideas and suggestions on the establishment of the index system. The summary of expert feedback is as follows.

1) In the first-grade index, experts believe that the summary of learning from experience of emergency management is very important, and therefore it is necessary to list specifically in the first-grade index and divide the index “Recovery of learning capability” into “Recovery capability” and “Learning capability”.

2) In the second-grade index, the index “Overall learning” is not clear so it is amended as “Case base learning”. The content of index “Recovery order” is too simple and should be revised to “Recovery construction”.

3) The amendments of the third-grade index include

A. Preventive capability Index. Under the second-grade index “Organizational structure”, “Expert team construction” is added as the third-grade index, and “Emergency education training” is added as the third-grade index under the second-grade index “Education training and drill”. In addition, the index under “Emergency funds and materials” is divided into two third-grade indexes “Emergency funds guarantee” and “Emergency material reserves”.

B. Disposal capability index. The content of “Information Transmission” under the second-grade index “Emergency coordinating” is too simple and should be revised as “Information collection, transmission and release”. The index “Communication and cooperation” is not unknown clearly and should be “Personnel communication and cooperation on campus. The “Isolation measures” under “Emergency control” is too single and should be “Damage control measures”.

C. Recovery capability index. The index “Investigation evaluation” under “post-emergency disposal” should be revised as “Event investigation and evaluation”, “Responsibility disposal as “Accountability disposal”. Under the index “Recovery construction”, a third-grade index “Recovery construction plan” should be added.

D. Learning capability index. “Case base construction and

management" should be added under the second-grade index as the third index. The content of "Information learning and sharing" is not clear and should be amended as "Case study and Information sharing."

According to the experts' suggestions, the indexes which have influence on the evaluation should be amended and added while the irrelevant indexes should be screened out. Finally, the emergency management index system including 4 first-grade indexes, 12 second-grade indexes and 36 three-grade indexes is determined. As shown in Table 4-2.

Table 4-2 Campus Emergency Management Capability Evaluation Index System

Evaluation Objects O	The first grade index A	The second grade index B	The third grade index C
Campus emergency management capability	Preventive capability Index A1	Organizational structure B1	Institution setting C1
			Job responsibility C2
			Emergency personnel's proportion and professional qualities C3
			Experts team building C4
		Information early-warning B2	Making emergency plan C5
			Risk information collection and evaluation C6
			Early-warning implementation C7
		Education training and drill B3	Educational training and drill plan C8
			Emergency education training C9
			Emergency drill implementation C10
		Funds, materials and facilities B4	Emergency funds guarantee C11
			Emergency material reserves C12
			Safety facilities and equipment C13
	Disposal capability index A2	Emergency organization B5	Leading organs C14
			Personnel response C15
		Emergency commanding B6	Pre-decision and disposal C16
			Emergency decision-making C17

Continued Table 4-2

Evaluation Objects O	The first grade index A	The second grade index B	The third grade index C
			Launching and implementation of emergency preplan C18
		Emergency coordinating B7	Information collection, transmission and release C19
			Material supply C20
			Personnel communication and collaboration on campus C21
			Joint cooperation with emergency force off campus C22
		Emergency controlling B8	Evacuation and rescue C23
			Damage control measuresC24
			Damage dynamic evaluation C25
	Recovery capability index A3	Post-emergency disposal B9	Investigation evaluation C26
			Accountability disposal C27
		Recovery construction B10	Recovery construction plan C28
			Facilities and system reconstruction C29
			Psychological intervention and counseling C30
	Learning capability Index A4	Case study B11	Cause analysis of events C31
			Summary of disposal process C32
			Organization experience learning C33
		Case base study B12	Case collection and summarization C34
			Case base construction and management C35
			Case study and information sharing C36

4.1.4 Standards for Campus Emergency Management Capability Evaluation Index

The three-leveled indexes set up in the index system are interpreted one by one, and the evaluation criteria are set up, so as to lay the foundation for compiling the questionnaire.

4.1.4.1 Preventive Capability Index

1) Organizational structure

A. Standard for evaluation on institution setting, whether it has established campus emergency management institution and reasonableness of institution setting.

B. Standard for evaluation on assignment of responsibility, whether there is assignment of responsibility, scientificity and reasonableness of assignment.

C. Standard for evaluation on emergency personnel' proportion and professional qualities, the proportion of professional emergency personnel and campus teachers and students, whether it carries out business assessment on professional emergency personnel.

2) Risk early-warning and control

A. Standard for evaluation on contingency plan, whether it will work out campus contingency plan and its efficiency and reasonableness.

B. Standard for evaluation on risk information collection and analysis. Whether collect potential risk information, whether evaluate risk information.

C. Standard for evaluation on early-warning implementation, whether campus emergency early-warning implementation institution is set up and reasonableness of early-warning implementation.

3) Education training and drill

A. Standard for evaluation on training and drill plan, whether campus emergency education training and drill plan is made and its reasonableness.

B. Standard for evaluation on emergency education training, whether emergency drill is regularly organized and its content, scale and scope.

4) Funds, materials and facilities

A. Standard for evaluation on emergency funds security, whether there is necessary investment of emergency funds and whether supplies and funds security arrangement are reasonable.

B. Standard for evaluation on emergency materials reserve, whether there is a need to purchase necessary materials and whether they are in good place and reasonable.

C. Standard for evaluation on facilities and equipment, whether there should be equipped with emergency equipment on campus and they are adequate and in good condition.

4.1.4.2 Disposal Capability Index

1) Emergency organizing

A. Standard for evaluation on leading organs, whether campus emergency leading organs are established and the reasonableness of jurisdiction capability.

B. Standard for evaluation on personnel response. After the emergency, whether officers of campus emergency management institution start up the emergency system according to procedures and strength of his emergency capability.

2) Emergency commanding

A. Standard for evaluation on pre-disposal. After emergency,

whether pre-disposal of campus emergency is prompt and in place, whether disposal methods are perfect and reasonable.

B. Standard for evaluation on launching and implementation of the plan. After emergency, whether start-up and implementation of the plan will be carried out according to grading response principle and the reasonableness of start-up and implementation.

3) Emergency coordinating

A. Standard for evaluation on information collection, transmission and release, whether emergency management personnel do information collection, whether information collection is real and complete, whether information transmission is prompt and effective and whether information distribution is accurate and consistent.

B. Standard for evaluation on material supply, whether there is emergency material supply in the disposal process of emergency, and its efficiency.

C. Standard for evaluation on campus personnel communication and collaboration, whether communication and coordination with relevant institutions and people on campus are made in time, fluency of communication and coordination.

D. Standard for evaluation on the joint coordination with emergency force off campus, whether communication and coordination is carried out with the news media, the government and the police and other external emergency force in a timely manner and the smoothness of its linkage with emergency disposal.

4) Emergency controlling

A. Standard for evaluation on evacuation and rescue, whether there

is prompt and orderly evacuation, and whether there is effective rescue for the injured.

B. Standard for evaluation on control measures, whether control measures are prompt, comprehensive and effective and whether they can prevent the situation from getting worse and avoid secondary disasters.

C. Standard for evaluation on damage dynamic evaluation, after emergency, whether an investigation is responsibly carried out to find out shortage and deficiency of emergency management and whether its investigation is comprehensive, timely and reasonable.

4.1.4.3 Recovery Capability Index

1) Disposal Afterwards

A. Standard for evaluation on cases investigation evaluation. After emergency, whether survey and learn lessons to make up inadequacy and shortcomings of emergency management are carried out and whether investigation evaluation is comprehensive, prompt and reasonable.

B. Standard for evaluation on accountability disposal, whether there is a sound accountability system, whether campus emergency accountability system is implemented after investigation and evaluation, and whether responsibility processing is objective, impartial and reasonable.

2) Recovery construction

A. Standard for evaluation on construction of facilities and policies, whether campus facilities and relevant equipment are promptly restored to ensure normal school routines and perfectness of facility and policy reconstruction.

B. Standard for evaluation on psychological intervention and counseling, whether psychological counseling teams are constructed in emergency management department constructs and whether professional personnel's knowledge and skills are used to relieve mental pressure of psychologically fragile people, including the scope, reasonableness and effect of psychological counseling.

4.1.4.4 Learning Capability Index

1) Case study

A. Standard for evaluation on cause analysis of events, whether an investigation is carefully carried out on event causes and whether a comprehensive and accurate analysis of event causes is made to learn the lessons and try so as to avoid similar events.

B. Standard for evaluation on summary of disposal process, whether an objective and overall summary of disposal process is made and whether the existing problems and shortcomings is found out in disposal process to achieve improvement and perfection.

2) Case base learning

A. Standard for evaluation on case collection and arrangement, whether all kinds of cases on campus and relevant typical cases off campus are collected, and whether prevention and disposal measures of all kinds of cases are summarized and comprehensiveness of collection and arrangement.

B. Standard for evaluation on case base construction and management. Whether more attention is paid to the construction of case base and there is

a special person responsible for classification, statistics and analysis of cases to set up a case base and compile case study materials.

C. Standard for evaluation on case study and information sharing, whether there are emergency management learning and training organized to enhance the awareness of teachers and students, and whether prevention measures and countermeasures of all kinds of cases are shared and communicated as well as reasonableness of information collection and sharing.

4.2 Index Weight of Campus Emergency Management Capability

The weight is obtained by using AHP and then amended by Entropy method in light of the former's likely shortcomings like poor transmission and inaccurate scaling.

4.2.1 Determination of Weight by AHP

According to the score of one expert, we use the AHP to establish the judgment matrix first, then calculate the eigenvalues and carry out consistency test, and finally get the index weight of the expert score. Similarly, other experts' scores can be calculated by the same method and steps, and the corresponding weight is obtained (Huang, Wang, & Wang, 2012). Finally, based on the weight of all experts' scoring calculated on average, the evaluation index weight of campus emergency management capability is obtained. The weight of the index is calculated with the score of expert U1 as an example.

The first step is to build hierarchical hierarchies. According to the mutual influence and affiliation of the index, the hierarchical structure of the research object can

be accurately evaluated (See Table 4-2).

In the second step, the judgment matrix is established. According to the relationship between the upper and lower indexes determined by Table 4-2, a judgment matrix is established according to the score of expert U1, and pairwise comparisons are made on the same level indexes. In the study, we established 4 first-grade indexes, A1-A4 for target judgment matrix (O-A), 12 for second-grade indexes B1-B12, for each judgment matrix (Ai-B) subordinate Ai, 36 third-grade indexes C1-C36 for each judgment matrix (Bj-C) subordinate Bj. When an expert is scoring, the importance of each index is valued at 1-9, and the important scale of its assignment is shown in Table 4-3.

Table 4-3 The Important Scale Meaning of The Assignment

scale	meaning
I=1	The two indexes are equally important
I=3,5,7,9	The former factor is slightly, obviously, strongly, and extremely important than the latter.
I=2,4,6,8	The upper two adjacent judgment median
I=1/3,1/5,1/7,1/9	The latter factor is slightly, obviously, strongly, and extremely important than the previous factor

Take the 4 first-grade index weight as an example, namely preventive capability, disposal capability, recovery capability and learning capability are respectively expressed as A1, A2, A3, A4. Then, the judgment matrix is shown in Table 4-4.

Table 4-4 Expert U1's Scoring Table of the First-grade Indexes

Judgment matrix	A_1	A_2	A_3	A_4
A_1	1	1	5	2
A_2	1	1	5	2
A_3	1/5	1/5	1	1/3
A_4	1/2	1/2	3	1

According to the analytic hierarchy process (AHP), the judgment matrix U is established by pairwise comparison.

$$U = (a_{ij})_{n\times n} = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{pmatrix} \qquad (i, j = 1,2,\cdots,n) \qquad (4.1)$$

Then, n is the number of indexes, and aij is the ratio of the importance of the index i to the index j.

Therefore, the expert U1's judgment matrix A for the 4 first-grade indexes is as follows

$$A = \begin{bmatrix} 1 & 1 & 5 & 2 \\ 1 & 1 & 5 & 2 \\ 1/5 & 1/5 & 1 & 1/3 \\ 1/2 & 1/2 & 3 & 1 \end{bmatrix}$$

The third step is calculating the weight vector. The “sum product method” is used to calculate the weight vector of the index.

Normalization of each column in the judgment matrix U

$$\bar{a}_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \qquad (i, j = 1,2,\cdots,n) \tag{4.2}$$

And the adding by lines to get the sum vector

$$W_i = \sum_{j=1}^{n} \bar{a}_{ij} \qquad (i, j = 1,2,\cdots,n) \tag{4.3}$$

Finally, the sum vector is normalized to get weight vector

$$\overline{W_i} = \frac{W_i}{\sum_{i=1}^{n} W_i} \qquad (i, j = 1,2,\cdots,n) \tag{4.4}$$

Calculating the maximum eigenvalue of the matrix

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{\left(U\overline{W_i}\right)_j}{n\overline{W_i}} \qquad (i, j, \cdots, n) \tag{4.5}$$

With the above "sum product" formula, we normalize the judgment matrix A of 4 first-grade indexes of campus emergency management capability, and calculate the corresponding weight vectors and the maximum eigenvalues, namely

$$\overline{W_1} = (0.3683 \quad 0.3683 \quad 0.0704 \quad 0.1929)$$

$$\lambda_{\max} = 4.0042$$

The fourth step, consistency test. It is pointed out that in practice, it is necessary to check whether the judgment matrix satisfies the consistency. Only by testing, the consistent judgment matrix is logical, so that we can continue to analyze and study its results (Xu, Qiu, & Zhao, 2010). The steps of consistency test are as follows.

1) Calculating Consistency Index C.I.

$$\text{C.I.} = \frac{\lambda_{\max} - n}{n-1} \tag{4.6}$$

The judgment matrix A of the 4 first-grade indexes

$$C.I. = \frac{\lambda_{\max} - n}{n-1} = 0.0014$$

2) The average random consistency index R.I. is determined by the table, and it is obtained by checking the table according to different orders of the judgment matrix.

Table 4-5 Average Random Consistency Test Index R.I.

n	3	4	5	6	7	8	9	10	11
R.I.	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

3) Calculating test index C.R.

$$C.R. = \frac{C.I.}{R.I.} \tag{4.7}$$

The judgment matrix A of the 4 first-grade indexes

$$C.R. = \frac{C.I.}{R.I.} = \frac{0.0014}{0.9} = 0.0015 < 0.1$$

The judgment matrix consistency index C.I. and test index C.R. for the 4 first-grade indexes of expert U1 are respectively 0.0014 and 0.0015. According to the definition of C.R.. When C.R.<0.1 is considered, the consistency of judgment matrix is acceptable. When C.R.>0.1, it is considered that the judgment matrix does not conform to the consistency, so we need to revise the judgment matrix. After testing, the judgment matrix of the 4 first-grade indexes of expert U1 has been proved to be in good consistency, and its weight results and test indexes are obtained, as shown in Table 4-6.

Table 4-6 The First-grade Index Judgment Matrix and Weight(O-A)

O	A_1	A_2	A_3	A_4	$\overline{W_1}$	λ_{max}	C.R
A_1	1	1	5	2	0.3683		
A_2	1	1	5	2	0.3683		
						4.0042	0.0015
A_3	1/5	1/5	1	1/3	0.0704		
A_4	1/2	1/2	3	1	0.1929		

By using the results of AHP, the weight ranking of the 4 first-grade indexes of expert U1 is as follows $\overline{W_{A1}} = \overline{W_{A2}} > \overline{W_{A4}} > \overline{W_{A3}}$

Similarly, we calculate each judgment matrix (Ai-B) of 12 two-grade indexes B1-B12 subordinate the first-grade Ai, each judgment matrix (Bj-C) of 36 third-grade indexes C1-C36 subordinate the second-grade index Bj, and carry out consistency test. For weight results and inspection indexes. See Table 4-7 to Table 4-22.

Table 4-7 Judgment Matrix and Weight of (A1-B)

A_1	B_1	B_2	B_3	B_4	$\overline{W_{21}}$	λ_{max}	C.R
B_1	1	2	3	4	0.4673		
B_2	1/2	1	2	3	0.2772		
						4.0310	0.0115
B_3	1/3	1/2	1	2	0.1601		
B_4	1/4	1/3	1/2	1	0.0954		

Table 4-8 Judgment Matrix and Weight of (A2-B)

A_2	B_5	B_6	B_7	B_8	$\overline{W_{22}}$	λ_{max}	C.R
B_5	1	6	6	2	0.5168		
B_6	1/6	1	1	1/5	0.0751	4.0328	0.0121
B_7	1/6	1	1	1/5	0.0751		
B_8	1/2	5	5	1	0.3329		

Table 4-9 Judgment Matrix and Weight of (A3-B)

A_3	B_9	B_{10}	$\overline{W_{23}}$	λ_{max}
B_9	1	5	0.8333	2
B_{10}	1/5	1	0.1667	

Table 4-10 Judgment Matrix and Weight of (A4-B)

A4	B11	B12	$\overline{W_{24}}$	λmax
B11	1	1/3	0.2500	2
B12	3	1	0.7500	

Table 4-11 Judgment Matrix and Weight of (B1-C)

B 1	C 1	C 2	C 3	C 4	$\overline{W_{31}}$	λmax	C.R
C 1	1	5	3	7	0.5738		
C 2	1/5	1	1/3	2	0.1077	4.0583	0.0216
C 3	1/3	3	1	4	0.2534		
C 4	1/7	1/2	1/4	1	0.0651		

Table 4-12 Judgment Matrix and Weight of (B2-C)

B 2	C5	C 6	C 7	$\overline{W_{32}}$	λmax	C.R
C 5	1	1/4	1/3	0.1260		
C 6	4	1	1	0.4579	3.0092	0.0079
C 7	3	1	1	0.4161		

Table 4-13 Judgment Matrix and Weight of (B3-C)

B 3	C 8	C 9	C 10	$\overline{W_{33}}$	λmax	C.R
C 8	1	1/4	1/3	0.1260		
C 9	4	1	1	0.4579	3.0092	0.0079
C 10	3	1	1	0.4161		

Table 4-14 Judgment Matrix and Weight of (B4-C)

B 4	C 11	C 12	C 13	$\overline{W_{34}}$	λmax	C.R
C 11	1	2	1/3	0.2297		
C 12	1/2	1	1/5	0.1220	3.0037	0.0032
C 13	3	5	1	0.6483		

Table 4-15 Judgment Matrix and Weight of (B5-C)

B5	C14	C15	$\overline{W_{35}}$	λmax
C14	1	2	0.6667	2
C15	1/2	1	0.3333	

Table 4-16 Judgment Matrix and Weight of (B6-C)

B6	C16	C17	C18	$\overline{W_{36}}$	λmax	C.R
C16	1	5	3	0.6483		
C17	1/5	1	1/2	0.1220	3.0037	0.0032
C18	1/3	2	1	0.2297		

Table 4-17 Judgment Matrix and Weight of (B7-C)

B7	C19	C20	C21	C22	$\overline{W_{37}}$	λmax	C.R
C19	1	4	1	6	0.4276	4.0145	0.0054
C20	1/4	1	1/3	2	0.1234		

Continued Table 4-17

B7	C19	C20	C21	C22	$\overline{W_{37}}$	λmax	C.R
C21	1	3	1	5	0.3796		
C22	1/6	1/2	1/5	1	0.0693		

Table 4-18 Judgment Matrix and Weight of (B8-C)

B8	C23	C24	C25	$\overline{W_{38}}$	λmax	C.R
C23	1	1	4	0.4579		
C24	1	1	3	0.4161	3.0092	0.0079
C25	1/4	1/3	1	0.1260		

Table 4-19 Judgment Matrix and Weight of (B9-C)

B9	C26	C27	$\overline{W_{39}}$	λmax
C26	1	3	0.7500	2
C27	1/4	1	0.2500	

Table 4-20 Judgment Matrix and Weight of (B10-C)

B10	C28	C29	C30	$\overline{W_{310}}$	λmax	C.R
C28	1	1/3	1/4	0.1270		
C29	4	1	1	0.4575	3.0185	0.0159
C30	3	1	1	0.4155		

Table 4-21 Judgment Matrix and Weight of (B11-C)

B11	C31	C32	C33	$\overline{W_{311}}$	λmax	C.R
C31	1	1	1/3	0.1919		
C32	1	1	1/4	0.1744	3.0092	0.0079
C33	3	4	1	0.6337		

Table 4-22 Judgment Matrix and Weight of (B12-C)

B12	C34	C35	C36	$\overline{W_{312}}$	λmax	C.R
C34	1	2	1/3	0.2297		
C35	1/2	1	1/5	0.1220	3.0037	0.0032
C36	3	5	1	0.6483		

From Table 4-7 to Table 4-22, the value of all C.R. is less than 0.1, so expert U1 has good consistency at all grades of judgment matrixes.

4.2.2 The weight amendment by Entropy method

In order to avoid poor transitivity and inaccurate scaling of expert scoring in the hierarchical analysis method and keep the weight of campus emergency management capability index more scientific and reasonable with more research value, it is necessary to use Entropy method to amend the weight obtained by AHP (Huang, Wang, & Wang, 2012). This paper uses the Entropy method to amend the index weight of campus emergency management capability and the specific steps are as follows.

1) Collecting data and constructing judgment matrix

$$A=\begin{pmatrix} x_{11} & .. & x_{1m} \\ .. & .. & .. \\ x_{n1} & .. & x_{nm} \end{pmatrix}_{n\times m} \tag{4.8}$$

Then, xij is the value of jth index of the ith scheme.

2) Calculating the weight p_{ij} of the item i in this index under the index of item j

$$p_{ij}=\frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}} \qquad (i=1,2,...,n;\quad j=1,2,...,m) \tag{4.9}$$

3) Calculating the entropy e_j of the jth index

$$e_j=-k\sum_{i=1}^{n} p_{ij}\ln(p_{ij}) \tag{4.10}$$

Then, $k>0,\quad k=1/\ln(n),\quad e_j\geq 0$.

4) Calculating difference coefficient of the item j. For the jth index, the greater the difference between indexes values is, the greater the impact on the evaluation is, and the smaller the entropy is. So the difference coefficient is g_j

$$g_j=\frac{1-e_j}{m-E_e} \tag{4.11}$$

Then, $E_e=\sum_{j=1}^{m} e_j$.

5) Calculating the weight coefficient μ_j of the evaluation index

$$\mu_j=\frac{g_j}{\sum_{j=1}^{m} g_j} \tag{4.12}$$

6) Using the weight coefficient μ_j calculated by the Entropy method to amend the weight coefficient ω_j calculated by the AHP and the objective index weight coefficient λ_j is obtained

$$\lambda_j = \frac{\mu_j \omega_j}{\sum_{j=1}^{n} \mu_j \omega_j} \tag{4.13}$$

According to the amendment by Entropy method, the weight coefficients in each grade index are obtained. See Table 4-23 to Table 4-35.

Table 4-23 Entropy Amendment Weight(O-A)

Index	e	g	μ	λ
A1	0.8951	0.0433	0.2479	0.3620
A2	0.8951	0.0433	0.2479	0.3620
A3	0.9046	0.0394	0.2254	0.0629
A4	0.8820	0.0487	0.2787	0.2131

Table 4-24 Entropy Amendment Weight(A1-B)

Index	e	g	μ	λ
B1	0.8962	0.0420	0.2213	0.4027
B2	0.8426	0.0638	0.3358	0.3624
B3	0.8691	0.0530	0.2792	0.1741
B4	0.9232	0.0311	0.1637	0.0608

Table 4-25 Entropy Amendment Weight(A2-B)

Index	e	g	μ	λ
B5	0.8086	0.0671	0.2247	0.4510
B6	0.8072	0.0676	0.2264	0.0660
B7	0.8072	0.0676	0.2264	0.0660
B8	0.7252	0.0963	0.3226	0.4170

Table 4-26 Entropy Amendment Weight(B1-C)

Index	e	g	μ	λ
C1	0.7883	0.0733	0.2388	0.5225
C2	0.7890	0.0731	0.2381	0.0978
C3	0.6917	0.1068	0.3479	0.3362
C4	0.8447	0.0538	0.1752	0.0435

Table 4-27 Entropy Amendment Weight(B2-C)

Index	e	g	μ	λ
C5	0.8869	0.0341	0.3528	0.1349
C6	0.8783	0.0366	0.3793	0.5270
C7	0.9141	0.0259	0.2679	0.3381

Table 4-28 Entropy Amendment Weight(B3-C)

Index	e	g	μ	λ
C8	0.8869	0.0341	0.3528	0.1349
C9	0.8783	0.0366	0.3793	0.5270
C10	0.9141	0.0259	0.2679	0.3381

Table 4-29 Entropy Amendment Weight(B4-C)

Index	e	g	μ	λ
C11	0.7725	0.0630	0.3726	0.2542
C12	0.8194	0.0500	0.2957	0.1072
C13	0.7976	0.0561	0.3316	0.6386

Table 4-30 Entropy Amendment Weight(B6-C)

Index	e	g	μ	λ
C16	0.7976	0.0561	0.3316	0.6386
C17	0.8194	0.0500	0.2957	0.1072
C18	0.7725	0.0630	0.3726	0.2542

Table 4-31 Entropy Amendment Weight(B7-C)

Index	e	g	μ	λ
C19	0.8291	0.0653	0.2766	0.4712
C20	0.8229	0.0677	0.2867	0.1410

Continued Table 4-31

Index	e	g	μ	λ
C21	0.8664	0.0510	0.2161	0.3269
C22	0.8637	0.0521	0.2206	0.0609

Table 4-32 Entropy Amendment Weight(B8-C)

Index	e	g	μ	λ
C23	0.8783	0.0366	0.3793	0.5270
C24	0.9141	0.0259	0.2679	0.3381
C25	0.8869	0.0341	0.3528	0.1349

Table 4-33 Entropy Amendment Weight(B10-C)

Index	e	g	μ	λ
C28	0.8869	0.0341	0.3528	0.1379
C29	0.9141	0.0259	0.2679	0.3771
C30	0.8783	0.0366	0.3793	0.4850

Table 4-34 Entropy Amendment Weight(B11-C)

Index	e	g	μ	λ
C31	0.8650	0.0384	0.2610	0.1510
C32	0.7897	0.0598	0.4066	0.2138
C33	0.8281	0.0489	0.3324	0.6352

Table 4-35 Entropy Amendment Weight(B12-C)

Index	e	g	μ	λ
C34	0.7725	0.0630	0.3726	0.2542
C35	0.8194	0.0500	0.2957	0.1072
C36	0.7976	0.0561	0.3316	0.6386

After entropy revision, expert U1 made evaluation on the weight of the index system, as shown in Table 4-36.

Table 4-36 The Weight of Evaluation Index System for Campus Emergency Management Capability of Expert U1

The first grade index A	The second grade index B		The third grade index C	AHP	Entropy
Preventive capability Index A1	Organizational structure B1		Institution setting C1	0.5738	0.5225
			Job responsibility C2	0.1077	0.0978
	AHP	Entropy	Emergency personnel's proportion and professional qualities C3	0.2534	0.3362
	0.4673	0.4027	Experts team building C4	0.0651	0.0435
	Information early-warning B2		Making emergency plan C5	0.1260	0.1349
	AHP	Entropy	Risk information collection and evaluation C6	0.4579	0.5270
	0.2772	0.3624	Early-warning implementation C7	0.4161	0.3381
	Educational training and drill B3		Educational training and drill plan C8	0.1260	0.1349
	AHP	Entropy	Emergency education training C9	0.4579	0.5270
	0.1601	0.1741	Emergency drill implementation C10	0.4161	0.3381
	Funds, materials and		Emergency funds guarantee C11	0.2297	0.2542

Continued Table 4-36

The first grade index A		The second grade index B		The third grade index C	AHP	Entropy
		facilities B4				
AHP	Entropy	AHP	Entropy	Emergency material reserves C12	0.1220	0.1072
0.3683	0.3620	0.0954	0.0608	Safety facilities and equipment C13	0.6483	0.6386
Disposal capability index A2		Emergency organizing B5		Leading organs C14	0.6667	0.6667
		AHP	Entropy	Personnel response C15	0.3333	0.3333
		0.5168	0.4510			
		Emergency commanding B6		Pre-decision and disposal C16	0.6483	0.6386
		AHP	Entropy	Emergency decision-making C17	0.1220	0.1072
		0.0751	0.0660	Launching and implementation of emergency preplan C18	0.2297	0.2542
		Emergency coordinating B7		Information collection, transmission and release C19	0.4276	0.4712
				Material supply C20	0.1234	0.1410
		AHP	Entropy	Personnel communication and collaboration on campus C21	0.3796	0.3269
		0.0751	0.0660	Joint cooperation with emergency force off campus C22	0.0693	0.0609
		Emergency controlling B8		Evacuation and rescue C23	0.4579	0.5270
AHP	Entropy	AHP	Entropy	Damage control measures C24	0.4161	0.3381
0.3683	0.3620	0.3329	0.4170	Damage dynamic evaluation C25	0.1260	0.1349
Recovery capability index A3		Post-emergency disposal B9		Investigation evaluation C26	0.7500	0.7500
		AHP	Entropy	Accountability disposal C27	0.2500	0.2500
		0.8333	0.8333			
		Recovery construction B10		Recovery construction plan C28	0.1270	0.1379
AHP	Entropy	AHP	Entropy	Facilities and system reconstruction C29	0.4575	0.3771

Continued Table 4-36

The first grade index A		The second grade index B		The third grade index C	AHP	Entropy
0.0704	0.0629	0.1667	0.1667	Psychological intervention and counseling C30	0.4155	0.4850
Learning capability Index A4		Case study B11		Cause analysis of events C31	0.1919	0.1510
		AHP	Entropy	Summary of disposal process C32	0.1744	0.2138
		0.2500	0.2500	Organization experience learning C33	0.6337	0.6352
		Case base study B12		Case collection and summarization C34	0.2297	0.2542
AHP	Entropy	AHP	Entropy	Case base construction and management C35	0.1220	0.1072
0.1929	0.2131	0.7500	0.7500	Case study and information sharing C36	0.6483	0.6386

Notes, there is no poor transitivity in the expert scoring when only two indexes are compared, and the weight obtained by AHP and Entropy method keeps the same. Therefore, only two indexes are compared without amendment. In Table 4-34, the ranking of index weights has changed after amending some index weights by entropy method. The third-grade index weight of Recovery construction (B10) by AHP ranks as Facilities and system reconstruction (C29), Psychological intervention and counseling (C30), Recovery construction plan (C28). The weight after amendment by entropy method ranks Psychological intervention and counseling (C30), Facilities and system reconstruction (C29), Recovery construction plan (C28). The third-grade index weight of Case study (B11)by AHP ranks as Organization experience learning (C33), Cause analysis of events (C31), Summary of disposal process (C32). The weight after amendment by entropy method ranks as Organization experience learning (C33), Summary of disposal process (C32), Cause analysis of events (C31).

Dong (2014) points out that the scientificity and reasonableness of the weight depends on the sample size surveyed by experts. The larger the sample size in theory is, the more reasonable the results are. Therefore, the weight gained from N experts' investigation is calculated equally. Finally, the weight of all experts is calculated, and the comprehensive weight of campus emergency management capability evaluation index system can be obtained. In this paper, 30 experts engaged in emergency management for more than 10 years are investigated and sampled, including 24 university experts, 3 government experts and 3 enterprise experts. See Table 3-1.

Through questionnaires survey, 28 valid questionnaires are obtained. After calculating and doing consistency tests, 4 did not pass the conformance test. The weight of 24 valid questionnaires was calculated to get average weight. Finally, the comprehensive weight of the index system of campus emergency management capability evaluation was finally obtained. See Table 4-37.

Table 4-37 Comprehensive Weight of Index System for Campus Emergency Management Capability Evaluation

The first grade index A	The second grade index B	The third grade index C	
Preventive capability Index A1 (0.3916)	Organizational structure B1 (0.3756)	Institution setting C1	(0.4367)
		Job responsibility C2	(0.1386)
		Emergency personnel’s proportion and professional qualities C3	(0.3170)
		Experts team building C4	(0.1077)
		Making emergency plan C5	(0.1807)

Continued Table 4-37

The first grade index A	The second grade index B	The third grade index C	
	Information early-warning B2 (0.3164)	Risk information collection and evaluation C6	(0.5081)
		Early-warning implementation C7	(0.3112)
	Educational training and drill B3 (0.2093)	Educational training and drill plan C8	(0.1673)
		Emergency education training C9	(0.4421)
		Emergency drill implementation C10	(0.3906)
	Funds, materials and facilities B4 (0.0987)	Emergency funds guarantee C11	(0.2269)
		Emergency material reserves C12	(0.2011)
		Safety facilities and equipment C13	(0.5720)
Disposal capability index A2 (0.3273)	Emergency organizing B5 (0.4055)	Leading organs C14	(0.5134)
		Personnel response C15	(0.4866)
	Emergency commanding B6 (0.1213)	Pre-decision and disposal C16	(0.5543)
		Emergency decision-making C17	(0.1890)
		Launching and implementation of emergency preplan C18	(0.2567)
	Emergency coordinating B7 (0.1002)	Information collection, transmission and release C19	(0.3619)
		Material supplyC20	(0.1720)
		Personnel communication and collaboration on campus C21	(0.3351)
		Joint cooperation with emergency force off campus C22	(0.1310)
	Emergency controlling B8 (0.3730)	Evacuation and rescue C23	(0.5176)
		Damage control measures C24	(0.3558)
		Damage dynamic evaluation C25	(0.1266)
Recovery capability index A3 (0.1179)	Post-emergency disposal B9 (0.6991)	Investigation evaluation C26	(0.6772)
		Accountability disposal C27	(0.3228)
	Recovery construction B10 (0.3009)	Recovery construction plan C28	(0.1671)
		Facilities and system reconstruction C29	(0.4416)

Continued Table 4-37

The first grade index A	The second grade index B	The third grade index C	
		Psychological intervention and counseling C30	(0.3913)
Learning capability Index A4 (0.1632)	Case study B11 (0.3552)	Cause analysis of events C31	(0.2149)
		Summary of disposal process C32	(0.1807)
		Organization experience learning C33	(0.6044)
	Case base study B12 (0.6448)	Case collection and summarization C34	(0.2531)
		Case base construction and management C35	(0.2436)
		Case study and information sharing C36	(0.5033)

4.3 Index Weight Verification of Campus Emergency Management Capability

In order to verify the reliability and rationality of the index weight, another 12 experts (2 government experts, 5 enterprise experts and 5 university experts. See Table 4-38) engaged in emergency management for more than 20 years are invited. They take responsibilities of sorting out and scoring the importance of the first-grade and second-grade indexes in the campus emergency management capability index system, and according to the ranking of the indexes from 12 experts, the consistency of the index weights of the 30 experts before is verified.

Table 4-38 The Expert Information of Index Importance Ranking

Expert number	Work unit	Job / Rank	Working length(year)	Sector
G4	Municipal Public Security Bureau of Chongqing	Inspector / grade 2 police commissioner	26	government
G5	Chongqing Institute of University Security	Vice President / deputy director	30	government
B4	Chongqing Iron and	Vice Minister of	21	enterprise

Continued Table 4-38

Expert number	Work unit	Job / Rank	Working length(year)	Sector
	Steel (Group) Co., Ltd	security / Engineer		
B5	China Jialing Industrial Co., Ltd.	Security Minister / Senior Engineer	24	enterprise
B6	China Nuclear Industry Jianfeng Chemical Plant	Deputy General Manager / Engineer	20	enterprise
B7	Southwest Aluminum (Group) Co., Ltd	Security Minister / Senior Engineer	21	enterprise
B8	Chongqing Electric Power Construction Corp	Vice Minister of security / Engineer	25	enterprise
U25	Chongqing University	Minister of security department / Professor	23	campus
U26	Southwestern University	Minister of Defense / Professor	20	campus
U27	Chongqing Medical University	Former Minister of Defend Department/ Professor	31	campus
U28	Chongqing Police College	Minister of Defense / Associate Professor	22	campus
U29	Chongqing University of Science and Technology	Minister of Defense / Associate Professor	20	campus

4.3.1 Verification Method

The method to verify index weight is to rank and score by 12 experts according to the importance of the index (see Appendix 3). According to the number of indexes in the same grade, the corresponding scores are filled based on the importance (The greater the score is, the more important the index is, and vice versa). Among them, the four first-grade indexes respectively correspond to the scores as 4,3,2,1. The 4 second-grade indexes of the preventive capability respectively correspond to the scores as 4,3,2,1. The four second-grade indexes of the disposal capability respectively correspond

to the scores as 4,3,2,1. And the 2 second-grade indexes of the recovery capability respectively correspond to the score as 2,1. And the 2 second-grade indexes of learning capability corresponds to the score as 2,1. Now take the expert U25's score table for example. See Table 4-39

Table 4-39 Expert U25's Index Importance Ranking

The first grade index A	scores	The second grade index B	scores
Preventive capability Index A1	4	Organizational structure B1	4
		Information early-warning B2	3
		Educational training and drill B3	2
		Funds, materials and facilities B4	1
Disposal capability index A2	3	Emergency organizing B5	4
		Emergency commanding B6	2
		Emergency coordinating B7	1
		Emergency controlling B8	3
Recovery capability index A3	1	Post-emergency disposal B9	2
		Recovery construction B10	1
Learning capability Index A4	2	Case study B11	1
		Case base study B12	2

4.3.2 Verification Results

According to experts' ranking of the importance of indexes, the scores of each index from 12 experts are calculated separately, and the comprehensive ranking results of the indexes can be obtained. See Table 4-40

Table 4-40 Comprehensive Ranking of the Index Importance

The first grade index A	scores	The second grade index B	scores
Preventive capability Index A1	45	Organizational structure B1	46
		Information early-warning B2	38
		Educational training and drill B3	20
		Funds, materials and facilities B4	16
Disposal capability index A2	39	Emergency organizing B5	44
		Emergency commanding B6	22
		Emergency coordinating B7	14
		Emergency controlling B8	40
Recovery capability index A3	16	Post-emergency disposal B9	19
		Recovery construction B10	17
Learning capability Index A4	20	Case study B11	15
		Case base study B12	21

By statistical comparison, the comprehensive importance ranking of the first grade and second indexes is consistent with comprehensive weight ranking. Thus, the reliability and rationality of the index weight are further verified.

4.4 Summary

According to the preliminary index design, the expert interview outline (see Appendix 1) is compiled and the expert forum is used to screen and amend campus emergency management capacity evaluation index. According to the 12 experts' suggestions, the indexes which have influence on the evaluation should be amended and added while the irrelevant indexes are screened out. Finally, the emergency management

index system including 4 first-grade indexes, 12 second-grade indexes and 36 three-grade indexes is determined.

This study has invited 30 experts engaged in emergency management for more than 10 years (experts in universities accounted for 80%, government experts for 10% and enterprises experts for 10%) to fill in the index questionnaire (see Appendix 2) and score the relative importance of each index, using AHP to determine the weights at all levels. In order to further solve some problems of poor transitivity and inaccurate scaling in the expert and ensure the weight of campus emergency management capability index more scientific and reasonable, with more research value, this paper uses Entropy method to amend the weight of and finally get the comprehensive weight of campus emergency management capability evaluation index system.

In order to verify the reliability and rationality of the index weight, another 12 experts (2 government experts, 5 enterprise experts and 5 university experts See Table 4-39) engaged in emergency management for more than 20 years are invited. They take responsibilities of sorting out and scoring the importance of the first-grade and second-grade indexes in the campus emergency management capability index system, and according to the ranking of indexes from 12 experts, the consistency of the index weights of the 30 experts before is verified.

CHAPTER 5

AN EMPIRICAL ANALYSIS ON CAMPUS EMERGENCY MANAGEMENT

Chongqing, a municipality directly under the central government of China, has a large number of colleges and universities in various levels and categories, and its geographical distribution is relatively concentrated. It can be used as a typical representative of universities in all provinces and cities in China. Therefore, this paper selects three colleges and universities in Chongqing to carry out empirical analysis. There are 64 colleges and universities in Chongqing, which are divided into three types, directly under the Ministry of education, ordinary public colleges and private colleges and universities. Among them, 2 belong to Ministry of Education directly, 37 public colleges and universities and 25 private colleges and universities (The Windows of Chinese Universities, 2017). According to the establishment of campus emergency management capability evaluation model, we select three universities like A (directly under the Ministry of Education), B (ordinary public colleges and university) and C (private university) to conduct empirical analysis, and provide decision-making basis for government departments and universities to build camps emergency management capabilities.

5.1 Sample Description

A is a national key university directly under the Ministry of Education, founded in 1929. It became a national comprehensive university with 6 colleges, including literature, science, engineering, commerce, law and medicine, as early as 1940s. The school now has 35 colleges, including the Ministry of literature, the Department of Social Sciences, the Department of science and science, the Department of engineering, the Department of architecture, and the Department of information. With 95 undergraduate programs, covering 10 disciplines such as science, engineering, economics and management, law, literature, history, philosophy, education and art. There are more than 47000 students in the school, including more than 18,000 graduate students of master's degree and PhD, nearly 26,000 undergraduates and 1,700 foreign students. Over 5,300 employees, including 5 members of the Chinese Academy of engineering and more than 2,100 professional and technical teachers and other professional and technical personnel above the level of associate professor, and over 700 doctoral tutors (including part-time) with 29 postdoctoral mobile stations. The campus covers an area of 5,212 mu, with four school districts and more than 160 square meters of building area.

B is a public full-time undergraduate college, founded in 1951, characterized by engineering, petroleum and chemical industry, metallurgy and materials, machinery and electronics, safety and environmental protection features, covering science, engineering, economics and management, law, literature and art. It integrates multidisciplinary coordinated development, highlighted industry advantage and the

distinctive characteristics of higher education. The school covers an area of 2,200 mu with more than 600,000 square meters of total area and the total value of the teaching instrument and equipment is 382 million yuan. The school library has a building area of more than 42,000 square meters, a collection of books of 2. 64 million books and a large number of digital information resources. There exist 1,549 staff, including 1,191 full-time teachers (1 academician of Academy of Sciences China, 1 Chinese Academy of engineering, and 488 professional and technical teachers and other professional and technical personnel above the level of associate professor, 302 people doctors and the proportion above master's degree is up to 87%, the number of full-time students more than reaches 20,000.

C is approved by the Ministry of Education. It is a private university based on engineering, which is characterized by software, electronic information, and coordinated development of disciplines such as economic management, humanities and art. The school always adheres to the education mode of "school-enterprise cooperation and combination of production and education", and has cultivated a large number of high-quality applied and technical skills talents in professional fields like software engineering, network engineering, network engineering, electronic information engineering, information security, cloud computing, digital media art, design and production, game animation e-commerce, marketing, financial management and information service that society badly needs. The campus covers an area of about 764 mu with about 302,900 square meters of the total area and the library's collection is more than 1.32 million books (including more than 590,000 books of electronic books). There

are more than 670 full-time teachers, 220 professional and technical teachers and other professional and technical personnel above the level of associate professor, accounting for more than 30% of the total number of full-time teachers. There are 343 full-time teachers with master degree or above, accounting for more than 50% of the total number of full-time teachers. The number of full-time students in the school reaches more than 13,500.

5.2 Introduction of the Questionnaire Survey

This part gives a detailed introduction to the questionnaire, sample size and reliability and validity of the formal questionnaire.

5.2.1 Introduction of The Questionnaire

According to the established campus emergency management capability evaluation model and the difference of index attributes in the model, we have made a questionnaire survey of leaders in charge of the school, leaders of the emergency management departments and the staff in the Campus A, B and C to conduct a comprehensive evaluation on emergency management capabilities of their schools. The main body of the index evaluation questionnaire consists of two parts (see Appendix 4). The first part mainly collects some information about individuals, including sex/gender, age, position, education level and so on. Through this analysis, the basic situation of the interviewees can be grasped as a whole, and it is beneficial to make a preliminary judgment on the validity of the questionnaire. The second part uses fuzzy comprehensive evaluation method to determine the membership of the third-grade indexes and measure

variables by using 5-grade scale table, 5-excellent, 4-good, 3-medium, 2-pass, 1-fail to evaluate the actual level of all indexes of campus emergency management capability evaluation.

5.2.2 Introduction of Sampling Survey

A total of 60 respondents are selected from each university, and 180 are determined from three campuses. The questionnaires were issued on-site, collected in limited time and when they were filled in successfully, respondents enclosed them in the envelope, and the author unified these questionnaires together. In the end, 172 questionnaires were re-collected (including 57 from campus A, 60 from B and 55 from C), and the recovery rate was 95.55%. Selecting returned questionnaires again, those that cannot meet the requirements were regarded as invalid questionnaires, leaving actually 169 valid questionnaires (including 55 from A, 60 from B, 54 from C), and the valid return rate was 93.88% (A 91.66%, B 100%, C 90%). In the analysis of the following data, 169 are used as the actual sample size.

5.2.3 Reliability and Validity Analysis of the Data

First, the reliability and validity of the data collected by the questionnaire are analyzed. The Cronbachα coefficient is used as the reliability test standard. After calculation, the Cronbachα coefficients of three universities were all above 0.8, indicating that the questionnaire had good or quite good internal consistency, and the reliability of the questionnaire was acceptable. Construct validity was conducted by factor analysis. After calculation, the factor loading of each measurement variable was above 0.6. Therefore, the validity of the questionnaire is acceptable.

5.3 Fuzzy Comprehensive Evaluation of Campus Emergency Management Capability

For a more intuitive presentation of campus emergency management capability evaluation process, this paper takes campus A as an example to calculate the excellency of A's emergency management capability evaluation index system by using multi-level fuzzy comprehensive evaluation model (Chen, 2014), the same as B and C.

5.3.1 The Determination of Membership

According to the requirements of fuzzy comprehensive evaluation model, we collect all questionnaires of Campus A to evaluate its emergency management capability by using fuzzy evaluation. And based on the evaluation criteria of Appendix 4, the respondents evaluate each index of campus A emergency management capability to determine the membership of the indexes at all levels. See Table 5-1.

Table 5-1 Membership of All-grade Indexes in Campus A

The first grade index A	The second grade index B	The third grade index C	weight	level				
				excellent	good	medium	pass	fail
Preventive capability IndexA1	Organizational structure B1 (0.3756)	Institution setting C1	0.4367	0.40	0.40	0.10	0.07	0.03
		Job responsibility C2	0.1386	0.33	0.37	0.17	0.07	0.07
		Emergency personnel's proportion and professional qualities C3	0.3170	0.23	0.27	0.20	0.17	0.13
		Experts team building C4	0.1077	0.17	0.33	0.37	0.10	0.03
	Information early-warning B2 (0.3164)	Making emergency plan C5	0.1807	0.33	0.50	0.17	0.00	0.00
		Risk information collection and evaluation C6	0.5081	0.37	0.40	0.13	0.10	0.00

Continued Table 5-1

The first grade index A	The second grade index B	The third grade index C	weight	level				
				excellent	good	medium	pass	fail
(0.3916)		Early-warning implementation C7	0.3112	0.13	0.23	0.40	0.23	0.00
	Educational training and drill B3 (0.2093)	Educational training and drill plan C8	0.1673	0.27	0.37	0.20	0.17	0.00
		Emergency education training C9	0.4421	0.30	0.40	0.13	0.13	0.03
		Emergency drills implementation C10	0.3906	0.27	0.43	0.20	0.07	0.03
	Funds, materials and facilities B4 (0.0987)	Emergency funds guaranteeC11	0.2269	0.23	0.27	0.27	0.17	0.07
		Emergency material reserves C12	0.2011	0.10	0.20	0.33	0.27	0.10
		Safety facilities and equipment C13	0.5720	0.37	0.43	0.20	0.00	0.00
Disposal capability index A2 (0.3273)	Emergency organizing B5 (0.4055)	Leading organs C14	0.5134	0.30	0.47	0.07	0.10	0.07
		Personnel response C15	0.4866	0.20	0.40	0.37	0.03	0.00
	Emergency commanding B6 (0.1213)	Pre-decision and disposal C16	0.5543	0.43	0.33	0.17	0.03	0.03
		Emergency decision-making C17	0.1890	0.27	0.53	0.20	0.00	0.00
		Launching and implementation of emergency preplan C18	0.2567	0.37	0.47	0.17	0.00	0.00
	Emergency coordinating B7 (0.1002)	Information collection, transmission and release C19	0.3619	0.33	0.27	0.23	0.13	0.03
		Material supplyC20	0.1720	0.17	0.27	0.20	0.27	0.10
		Personnel communication and collaboration on campus C21	0.3351	0.30	0.47	0.20	0.03	0.00
		Joint cooperation with emergency force off campus C22	0.1310	0.40	0.43	0.17	0.00	0.00
	Emergency controlling B8 (0.3730)	Evacuation and rescue C23	0.5176	0.50	0.33	0.10	0.07	0.00
		Damage control measures C24	0.3558	0.33	0.27	0.17	0.17	0.07

Continued Table 5-1

The first grade index A	The second grade index B	The third grade index C	weight	level				
				excellent	good	medium	pass	fail
		Damage dynamic evaluation C25	0.1266	0.27	0.33	0.27	0.13	0.00
Recovery capability index A3 (0.1179)	Post-emergency disposal B9 (0.6991)	Investigation evaluation C26	0.6772	0.33	0.27	0.30	0.10	0.00
		Accountability disposal C27	0.3228	0.40	0.43	0.07	0.07	0.03
	Recovery construction B10 (0.3009)	Recovery construction plan C28	0.1671	0.23	0.27	0.23	0.17	0.10
		Facilities and system reconstructionC29	0.4416	0.40	0.27	0.17	0.17	0.00
		Psychological intervention and counseling C30	0.3913	0.27	0.23	0.23	0.17	0.10
Learning capability Index A4 (0.1632)	Case study B11 (0.3552)	Cause analysis of events C31	0.2149	0.17	0.33	0.27	0.23	0.00
		Summary of disposal process C32	0.1807	0.10	0.27	0.37	0.17	0.10
		Organization experience learning C33	0.6044	0.33	0.17	0.17	0.27	0.07
	Case base study B12 (0.6448)	Case collection and summarization C34	0.2531	0.17	0.27	0.40	0.10	0.07
		Case base construction and management C35	0.2436	0.20	0.30	0.33	0.13	0.03
		Case study and information sharing C36	0.5033	0.10	0.17	0.33	0.23	0.17

5.3.2 Fuzzy Evaluation of the Second-grade Index

1) The fuzzy comprehensive evaluation of the preventive capability – the organization index

Assuming evaluation matrix R21 of the preventive capability is set up, and the evaluation result is B21

$$B_{21} = W_{21} \circ R_{21} = \begin{pmatrix} 0.4367 & 0.1386 & 0.3170 & 0.1077 \end{pmatrix} \begin{pmatrix} 0.40 & 0.40 & 0.10 & 0.07 & 0.03 \\ 0.33 & 0.37 & 0.17 & 0.07 & 0.07 \\ 0.23 & 0.27 & 0.20 & 0.17 & 0.13 \\ 0.17 & 0.33 & 0.37 & 0.10 & 0.03 \end{pmatrix}$$

$$B_{21} = \begin{pmatrix} 0.3116 & 0.3471 & 0.1705 & 0.1049 & 0.0672 \end{pmatrix}$$

2) Similarly

$$B_{22} = \begin{pmatrix} 0.2881 & 0.3652 & 0.2213 & 0.1224 & 0 \end{pmatrix}$$

$$B_{23} = \begin{pmatrix} 0.2833 & 0.4067 & 0.1691 & 0.1133 & 0.0250 \end{pmatrix}$$

$$B_{24} = \begin{pmatrix} 0.2839 & 0.3474 & 0.2420 & 0.0929 & 0.0360 \end{pmatrix}$$

$$B_{25} = \begin{pmatrix} 0.2513 & 0.4359 & 0.2160 & 0.0659 & 0.0359 \end{pmatrix}$$

$$B_{26} = \begin{pmatrix} 0.3844 & 0.4037 & 0.1757 & 0.0166 & 0.0166 \end{pmatrix}$$

$$B_{27} = \begin{pmatrix} 0.3016 & 0.3580 & 0.2069 & 0.1035 & 0.0281 \end{pmatrix}$$

$$B_{28} = \begin{pmatrix} 0.4104 & 0.3087 & 0.1464 & 0.1132 & 0.0249 \end{pmatrix}$$

$$B_{29} = \begin{pmatrix} 0.3526 & 0.3216 & 0.2258 & 0.0903 & 0.0097 \end{pmatrix}$$

$$B_{210} = \begin{pmatrix} 0.3207 & 0.2543 & 0.2035 & 0.1700 & 0.0558 \end{pmatrix}$$

$$B_{211} = \begin{pmatrix} 0.2541 & 0.2225 & 0.2276 & 0.2433 & 0.0604 \end{pmatrix}$$

$$B_{212} = \begin{pmatrix} 0.1421 & 0.2270 & 0.3477 & 0.1727 & 0.1106 \end{pmatrix}$$

3) To sum up, fuzzy relation matrix R1 of the first-grade index can be obtained

$$R_{11} = \begin{pmatrix} B_{21} & B_{22} & B_{23} & B_{24} \end{pmatrix}^T$$

$$R_{12} = \begin{pmatrix} B_{25} & B_{26} & B_{27} & B_{28} \end{pmatrix}^T$$

$$R_{13} = (B_{29} \quad B_{210})^T$$

$$R_{14} = (B_{211} \quad B_{212})^T$$

5.3.3 Fuzzy Evaluation of First-grade Index

1) Fuzzy comprehensive evaluation of preventive capability index

Assuming evaluation matrix R11 of the preventive capability is set up, and the evaluation result is B11

$$B_{11} = W_{11} \circ R_{11} = (0.3756 \quad 0.3164 \quad 0.2093 \quad 0.0987) \begin{pmatrix} 0.3116 & 0.3471 & 0.1705 & 0.1049 & 0.0672 \\ 0.2881 & 0.3652 & 0.2213 & 0.1224 & 0 \\ 0.2833 & 0.4067 & 0.1691 & 0.1133 & 0.0250 \\ 0.2839 & 0.3474 & 0.2420 & 0.0929 & 0.0360 \end{pmatrix}$$

$$B_{11} = (0.2955 \quad 0.3653 \quad 0.1933 \quad 0.1110 \quad 0.0340)$$

2) Similarly

$$B_{12} = (0.3318 \quad 0.3767 \quad 0.1842 \quad 0.0813 \quad 0.0287)$$

$$B_{13} = (0.3430 \quad 0.3014 \quad 0.2191 \quad 0.1143 \quad 0.0236)$$

$$B_{14} = (0.1819 \quad 0.2254 \quad 0.3051 \quad 0.1978 \quad 0.0928)$$

3) To sum up, fuzzy relation matrix R1of the first-grade index can be obtained

$$R_1 = (B_{11} \quad B_{12} \quad B_{13} \quad B_{14})^T$$

5.3.4 Fuzzy Comprehensive Evaluation of Emergency Management Capability of Campus A

The fuzzy comprehensive evaluation of the emergency management capability of campus A is made. According to the results of the first-grade index weight vector, the fuzzy evaluation results of the emergency management capability of Campus A are as follows

$$B_{Acumpus} = W_1 \circ R_1 = \begin{pmatrix} 0.3916 & 0.3273 & 0.1179 & 0.1632 \end{pmatrix} \begin{pmatrix} 0.2955 & 0.3653 & 0.1933 & 0.1110 & 0.0340 \\ 0.3318 & 0.3767 & 0.1842 & 0.0813 & 0.0287 \\ 0.3430 & 0.3014 & 0.2191 & 0.1143 & 0.0236 \\ 0.1819 & 0.2254 & 0.3051 & 0.1978 & 0.0928 \end{pmatrix}$$

$$B_{Acumpus} = \begin{pmatrix} 0.2945 & 0.3387 & 0.2116 & 0.1159 & 0.0406 \end{pmatrix}$$

According to the principle of maximum degree of membership, it shows that the emergency management capability of campus A belongs to the level of "good".

5.3.5 Fuzzy Comprehensive Evaluation of Emergency Management Capability of Campus B

Table 5-2 Membership of All-grade Indexes in Campus B

The first grade index A	The second grade index B	The third grade index C	Weight	level				
				excellent	good	medium	pass	fail
Preventive capability Index A1 (0.3916)	Organizational structure B1 (0.3756)	Institution setting C1	0.4367	0.29	0.30	0.15	0.17	0.09
		Job responsibility C2	0.1386	0.24	0.27	0.25	0.13	0.11
		Emergency personnel's proportion and professional qualities C3	0.3170	0.15	0.18	0.20	0.34	0.13
		Experts team building C4	0.1077	0.12	0.20	0.41	0.12	0.15
	Information early-warning B2 (0.3164)	Making emergency plan C5	0.1807	0.21	0.22	0.30	0.22	0.05
		Risk information collection and evaluation C6	0.5081	0.30	0.33	0.37	0	0
		Early-warning implementation C7	0.3112	0.14	0.21	0.40	0.18	0.07
	Educational training and drill B3 (0.2093)	Educational training and drill plan C8	0.1673	0.23	0.23	0.33	0.16	0.05
		Emergency education training C9	0.4421	0.19	0.25	0.30	0.13	0.13
		Emergency drill implementation C10	0.3906	0.17	0.20	0.24	0.19	0.20

Continued Table 5-2

The first grade index A	The second grade index B	The third grade index C	Weight	level				
				excellent	good	medium	pass	fail
	Funds, materials and facilities B4 (0.0987)	Emergency funds guarantee C11	0.2269	0.12	0.19	0.26	0.31	0.12
		Emergency material reserves C12	0.2011	0.09	0.14	0.34	0.27	0.16
		Safety facilities and equipment C13	0.5720	0.14	0.21	0.30	0.14	0.21
Disposal capability index A2 (0.3273)	Emergency organizing B5 (0.4055)	Leading organs C14	0.5134	0.17	0.20	0.34	0.18	0.11
		Personnel response C15	0.4866	0.13	0.23	0.37	0.14	0.13
	Emergency commanding B6 (0.1213)	Pre-decision and disposa C16	0.5543	0.20	0.21	0.37	0.08	0.14
		Emergency decision-making C17	0.1890	0.21	0.18	0.32	0.12	0.17
		Launching and implementation of emergency preplan C18	0.2567	0.14	0.19	0.28	0.16	0.23
	Emergency coordinating B7 (0.1002)	Information collection, transmission and release C19	0.3619	0.10	0.17	0.29	0.26	0.18
		Material supply C20	0.1720	0.15	0.19	0.24	0.32	0.10
		Personnel communication and collaboration on campus C21	0.3351	0.18	0.21	0.31	0.10	0.20
		Joint cooperation with emergency force off campus C22	0.1310	0.16	0.14	0.25	0.21	0.24
	Emergency controlling B8 (0.3730)	Evacuation and rescue C23	0.5176	0.15	0.21	0.32	0.21	0.11
		Damage control measures C24	0.3558	0.19	0.18	0.29	0.17	0.17
		Damage dynamic evaluation C25	0.1266	0.09	0.14	0.27	0.25	0.25
Recovery capability index A3 (0.1179)	Post-emergency disposal B9 (0.6991)	Investigation evaluation C26	0.6772	0.13	0.17	0.31	0.23	0.16
		Accountability disposal C27	0.3228	0.14	0.23	0.42	0.07	0.14
	Recovery construction B10	Recovery construction plan C28	0.1671	0.11	0.17	0.26	0.28	0.18

Continued Table 5-2

The first grade index A	The second grade index B	The third grade index C	Weight	level				
				excellent	good	medium	pass	fail
	(0.3009)	Facilities and system reconstruction C29	0.4416	0.21	0.13	0.34	0.21	0.11
		Psychological intervention and counseling C30	0.3913	0.08	0.14	0.37	0.28	0.13
Learning capability Index A4 (0.1632)	Case study B11 (0.3552)	Cause analysis of events C31	0.2149	0.11	0.19	0.30	0.30	0.10
		Summary of disposal process C32	0.1807	0.10	0.20	0.29	0.29	0.12
		Organization experience learning C33	0.6044	0.14	0.15	0.33	0.25	0.13
	Case base study B12 (0.6448)	Case collection and summarization C34	0.2531	0.13	0.16	0.41	0.21	0.09
		Case base construction and management C35	0.2436	0.12	0.19	0.38	0.10	0.21
		Case study and information sharing C36	0.5033	0.09	0.11	0.35	0.28	0.17

Similar to Campus A, the evaluation of the emergency management capability of B can be obtained

$$B_{Bcumpus} = (0.1675 \quad 0.2071 \quad 0.3154 \quad 0.1832 \quad 0.1268)$$

Therefore, Campus B is in medium.

5.3.6 Fuzzy Comprehensive Evaluation of Emergency Management Capability of Campus C

Table 5-3 Membership of All-grade Indexes in Campus C

The first grade index A	The second grade index B	The third grade index C	Weight	level				
				excellent	good	medium	pass	fail
Preventive capability	Organizational structure	Institution setting C1	0.4367	0.20	0.24	0.17	0.32	0.07

Continued Table 5-3

The first grade index A	The second grade index B	The third grade index C	Weight	level				
				excellent	good	medium	pass	fail
Index A1 (0.3916)	B1 (0.3756)	Job responsibility C2	0.1386	0.21	0.25	0.26	0.17	0.11
		Emergency personnel's proportion and professional qualities C3	0.3170	0.15	0.19	0.20	0.36	0.10
		Experts team building C4	0.1077	0.12	0.21	0.37	0.17	0.13
	Information early-warning B2 (0.3164)	Making emergency plan C5	0.1807	0.21	0.22	0.31	0.21	0.05
		Risk information collection and evaluation C6	0.5081	0.16	0.24	0.35	0.25	0
		Early-warning implementation C7	0.3112	0.13	0.22	0.40	0.22	0.03
	Educational training and drill B3 (0.2093)	Educational training and drill plan C8	0.1673	0.20	0.23	0.34	0.16	0.07
		Emergency education training C9	0.4421	0.17	0.21	0.30	0.23	0.09
		Emergency drill implementation C10	0.3906	0.13	0.20	0.31	0.20	0.16
	Funds, materials and facilities B4 (0.0987)	Emergency funds guaranteeC11	0.2269	0.11	0.18	0.26	0.35	0.10
		Emergency material reserves C12	0.2011	0.10	0.14	0.34	0.28	0.14
		Safety facilities and equipment C13	0.5720	0.09	0.19	0.29	0.24	0.19
Disposal capability index A2 (0.3273)	Emergency organization B5 (0.4055)	Leading organs C14	0.5134	0.11	0.20	0.34	0.25	0.10
		Personnel response C15	0.4866	0.15	0.22	0.37	0.14	0.12
	Emergency commanding B6 (0.1213)	Pre-decision and disposal C16	0.5543	0.12	0.19	0.37	0.19	0.13
		Emergency decision-making C17	0.1890	0.13	0.17	0.32	0.23	0.15
		Launching and implementation of emergency preplan C18	0.2567	0.11	0.15	0.28	0.26	0.20
	Emergency coordination B7	Information collection, transmission and release C19	0.3619	0.09	0.16	0.28	0.31	0.16

Continued Table 5-3

The first grade index A	The second grade index B	The third grade index C	Weight	level				
				excellent	good	medium	pass	fail
	(0.1002)	Material supply C20	0.1720	0.12	0.18	0.27	0.34	0.09
		Personnel communication and collaboration on campus C21	0.3351	0.14	0.20	0.33	0.12	0.21
		Joint cooperation with emergency force off campus C22	0.1310	0.13	0.15	0.24	0.27	0.21
	Emergency control B8 (0.3730)	Evacuation and rescue C23	0.5176	0.12	0.17	0.30	0.32	0.09
		Damage control measures C24	0.3558	0.15	0.18	0.31	0.22	0.14
		Damage dynamic evaluation C25	0.1266	0.08	0.11	0.28	0.29	0.24
Recovery capability index A3 (0.1179)	Post-emergency disposal B9 (0.6991)	Investigation evaluation C26	0.6772	0.13	0.16	0.32	0.22	0.17
		Accountability disposal C27	0.3228	0.10	0.15	0.43	0.16	0.16
	Recovery construction B10 (0.3009)	Recovery construction plan C28	0.1671	0.09	0.13	0.25	0.39	0.14
		Facilities and system reconstructionC29	0.4416	0.12	0.14	0.38	0.23	0.13
		Psychological intervention and counseling C30	0.3913	0.10	0.12	0.39	0.25	0.14
Learning capability Index A4 (0.1632)	Case study B11 (0.3552)	Cause analysis of events C31	0.2149	0.11	0.19	0.32	0.26	0.12
		Summary of disposal process C32	0.1807	0.09	0.20	0.30	0.25	0.16
		Organization experience learning C33	0.6044	0.12	0.13	0.34	0.26	0.15
	Case base study B12 (0.6448)	Case collection and summarization C34	0.2531	0.11	0.14	0.43	0.24	0.08
		Case base construction and management C35	0.2436	0.10	0.16	0.36	0.22	0.16
		Case study and information sharing C36	0.5033	0.08	0.11	0.38	0.28	0.15

Similar to campus A the evaluation of the emergency management capability can be obtained

$$B_{C\text{cumpus}} = (0.1338 \quad 0.1863 \quad 0.3212 \quad 0.2446 \quad 0.1141)$$

Therefore, Campus C is in medium.

5.3.7 Security Level Evaluation

In order to evaluate the emergency management capability of three campuses, the specific scores are given in the corresponding evaluation set, and the formula can be used. yk=(95,85,75,65,50)

$$W_P = \sum_{k=1}^{m} b_{pk} y_k \tag{5.1}$$

Then, p= Campus A, Campus B, Campus C. m=5. yk = (the score of excellent, the score of good, the score of medium, the score of pass, the score of fail).

Therefore, $W_{A\text{cumpus}} = 82.2005$, $W_{B\text{cumpus}} = 75.419$, $W_{C\text{cumpus}} = 74.011$.

Therefore, according to campus emergency management capacity evaluation standard. When the final evaluation results are in 90-100 points (including 90), it can be seen that the campus emergency management capability is excellent. When in 80-90 points (including 80), the emergency management capability is good. When in 70-80 points (including 70), the emergency management capability is medium. When in 60-70 points (including 60), the emergency management capability is just qualified. When below 60 points, the school emergency management capability is unqualified. Therefore, the final result of emergency management capability of Campus A, B and C University is respectively good, medium and medium.

5.4 Membership Degree Analysis of The Campus Emergency Management Capability Index in Sample Universities

From the above evaluation, it can be seen that the emergency management capability of Campus A is better than that of B and C, and the latter two is roughly equal. The membership degree of each index can be seen in Table 5-4.

Table 5-4 Membership of All-grade Indexes in Campus A, B and C

The first grade index A	The second grade index B	The third grade index C	Campus A	Campus B	Campus C
Preventive capability Index A1	Organizational structure B1	Institution setting C1	excellent	good	pass
		Job responsibility C2	good	good	medium
	Campus A / Campus B / Campus C	Emergency personnel's proportion and professional qualities C3	good	pass	pass
	good / good / medium	Experts team building C4	medium	medium	medium
	Information early-warning B2	Making emergency plan C5	good	medium	medium
	Campus A / Campus B / Campus C	Risk information collection and evaluation C6	good	medium	medium
	good / medium / medium	Early-warning implementation C7	medium	medium	medium
	Educational training and drill B3	Educational training and drill plan C8	good	medium	medium
	Campus A / Campus B / Campus C	Emergency education training C9	good	medium	medium
	good / medium / medium	Emergency drill implementation C10	good	medium	medium
	Funds, materials and facilities B4	Emergency funds guaranteeC11	good	pass	pass
	Campus A / Campus B / Campus C	Emergency material reserves C12	medium	medium	medium
	good / medium / medium	Safety facilities and equipment C13	good	medium	medium

Continued Table 5-4

The first grade index A	The second grade index B	The third grade index C	Campus A	Campus B	Campus C
Disposal capability index A2	Emergency organizing B5	Leading organs C14	good	medium	medium
	Campus A good / Campus B medium / Campus C medium	Personnel response C15	good	medium	medium
	Emergency commanding B6	Pre-decision and disposal C16	excellent	medium	medium
	Campus A good / Campus B medium / Campus C medium	Emergency decision-making C17	good	medium	medium
		Launching and implementation of emergency preplan C18	good	medium	medium
	Emergency coordinating B7	Information collection, transmission and release C19	excellent	medium	pass
		Material supply C20	good	pass	pass
	Campus A good / Campus B medium / Campus C pass	Personnel communication and collaboration on campus C21	good	medium	medium
		Joint cooperation with emergency force off campus C22	good	medium	pass
	Emergency controlling B8	Evacuation and rescue C23	good	medium	pass
	Campus A good / Campus B medium / Campus C pass	Damage control measures C24	excellent	medium	medium
		Damage dynamic evaluation C25	good	medium	pass
Recovery capability index A3	Post-emergency disposal B9	Investigation evaluation C26	excellent	medium	medium
	Campus A excellent / Campus B medium / Campus C medium	Accountability disposal C27	excellent	medium	medium
	Recovery construction B10	Recovery construction plan C28	good	pass	pass
	Campus A excellent / Campus B medium / Campus C medium	Facilities and system reconstructionC29	excellent	medium	medium
		Psychological intervention and counseling C30	excellent	medium	medium

Continued Table 5-4

The first grade index A	The second grade index B			The third grade index C	Campus A	Campus B	Campus C
Learning capability Index A4	Case study B11			Cause analysis of events C31	good	pass	medium
	Campus A	Campus B	Campus C	Summary of disposal process C32	medium	pass	medium
	excellent	medium	medium	Organization experience learning C33	excellent	medium	medium
	Case base study B12			Case collection and summarization C34	medium	medium	medium
	Campus A	Campus B	Campus C	Case base construction and management C35	medium	medium	medium
	medium	medium	medium	Case study and information sharing C36	medium	medium	medium

5.4.1 Situation Analysis on the Emergency Management Capability of Campus A

The maximum membership of campus emergency management capability index of Campus A, preventive capability (A1), good, disposal capability (A2), good, recovery capability (A3), excellent, learning capability (A4), medium. The comprehensive membership ranks as recovery capability is higher than disposal capability than preventive capability than learning capability.

Campus A is a national key university directly under the Ministry of Education. The overall level of emergency management capability is good. Most of the indexes belong to good or above, but some of them belong to the medium. Among them, the indexes with relatively lower membership level are Experts Team Building (C4) in the Organizational Structure (B1), Early-warning Implementation (C7) in the Information Early-warning (B2), Emergency Material Reserves (C12) in the Funds, Materials and

Facilities (B4), Summary of Disposal Process (C32) in Case Study (B11), Case Collection and Summarization (C34) in Case Base Study (B12), Case Base Construction and Management (C35), Case Study and Information Sharing (C36). Although Campus A has good emergency management capability, these indexes with relatively low membership levels are at relatively weak points in Campus A's emergency management capability, which needs further improvement and strengthening.

5.4.2 Situation Analysis on the Emergency Management Capability of Campus B

The maximum membership of the campus emergency management capability index in Campus B, preventive capability (A1) the medium; disposal capability (A2), good; recovery (A3) capability, good; and learning capability (A4), the medium. The comprehensive membership ranks as disposal capability is higher than recovery capability than preventive capability than learning capability.

Campus B is a full-time public university. The overall level of emergency management capability belongs to the medium. Most of the indexes belong to the medium or above level, but some of them are qualified. Among them, the indexes with relatively lower membership level are Emergency personnel's proportion and professional qualities (C3) in Organizational Structure (B1), Emergency Funds Guarantee (C11) in Funds, Materials and Facilities (B4), Material Supply (C20) in the Emergency Coordination (B7), Recovery Construction Plan (C28) in the Recovery Construction (B10), Analysis of Cause Analysis of Events (C31) and the Summary of Disposal Process (C32) in Case Study (B11). Because Campus B's emergency management capability is

generally at a medium level, and all indexes need to be improved. However, those indexes with lower membership degree are at weak points in the emergency management capability of Campus B, and needs further improvement and strengthening.

5.4.3 Situation Analysis on the Emergency Management Capability of Campus C

The maximum membership of the campus emergency management capability index in Campus B, preventive capability (A1), the medium, disposal capability (A2), good, recovery (A3) capability, medium, learning capability (A4), the medium. The comprehensive membership ranks as disposal capability is higher than recovery capability than preventive capability than learning capability.

Campus C is a private university. The overall level of emergency management belongs to the medium. Most of the indexes belong to the medium or above level, but some of them belong are qualified. Among them, the indexes with relatively lower membership are institution setting (C1) and Emergency personnel's proportion and professional qualities (C3) in the Organizational Structure (B1), Emergency Funds Guarantee (C11) in Funds, Materials and Facilities (B4), Information Collection, Transmission and Release (C19), Material Supply (C20) and Joint cooperation with emergency force off campus (C22) in Emergency Coordination (B7), Evacuation and Rescue (C23) and Damage Dynamic Evaluation (C25) in Emergency Control (B8), Recovery Construction Plan (C28) in Recovery Construction (B10). Because Campus C's emergency management capability is generally at a medium level, and all indexes need to be improved. However, those indexes with lower membership are weak points in the

emergency management capability of Campus C, and needs further improvement and strengthening.

According to the membership degree of each index in the three universities, generally they have better disposal and recovery capabilities to deal with emergencies, but their preventive capability and learning capability are relatively poor. The reason mainly lies in the relatively lower membership of these indexes in the evaluation, like emergency personnel's proportion and professional qualities, experts team building, risk warning of information, education training and drill, information transmission and release, launching and implementation of emergency preplan, cooperation of internal and external emergency forces, emergency funds and supplies, the construction of case base and information sharing, all of which affect the overall score. Therefore, the preventive and learning capability in the emergency management of colleges and universities is the weak link and also the key. Campus emergency management is a cycle process. Although the disposal and recovery capability is the core process, the key to improve emergency management is prevention and learning. To improve emergency management capability, we should fully implement the principle of "prevention first" and focus on strengthening the construction of preventive capability, while learning capability is to strengthen the preventive capability and a weak link of campus emergency management. This research will put forward some suggestions on the preventive and learning capability of the campus emergency management in the conclusion part.

5.5 Summary

Combined with the evaluation model of campus emergency management capability, this paper selects A, B, C three different types of colleges and universities to carry out an empirical analysis of their emergency management capabilities. After the index evaluation questionnaire (see Appendix 4), we collect the statistical analysis of data, and used the multi-level fuzzy comprehensive evaluation method to get the ranking of the three universities' emergency management capability. By finding common problems existing in them as for emergency management capacity, we put forward countermeasures and suggestions for government departments and universities to strengthen emergency management capacity construction.

CHAPTER 6

CONCLUSION AND SUGGESTIONS

6.1 Discussion and Conclusion

Through comparative discussion between the index system established in this study and other studies, the characteristics and advantages of this index system are elaborated in detail. And on this basis, the conclusion is made that the preventive and learning capabilities of the emergency management should be specially strengthened by ranking the index weight and analyzing the causality of the index.

6.1.1 Campus Emergency Management Index System

Compared with the index system of emergency management capabilities like (Eileen & Stephanie, 2011. Borum & Cornell, 2010. Henstra, 2010. Simpson & Katirai, 2006. How & Tom, 2006. Jackson & Sullivan, 2011. Australian scholar, 2002. Hu & Zhu, 2010. Chen, 2011. Zhang, 2011. Ji, Su, & Lv, 2012) , this study explores from literatures to campus emergency management capability index system established by experts, including preventive capability, disposal capability, recovery capability and learning capability, 4 first-grade indexes and 12 second-grade indexes and 36 third-grade indexes, which keeps more in line with the actual work of campus emergency management. The specific performance is the following four aspects.

1) The selection of indexes. Hu and Zhu (2010) and et al have set up combined index system of campus emergency management capability evaluation in

five aspects of abilities such as emergency warning, basic guarantee, rapid response, emergency disposal and emergency research management. Zhang (2011) has built the capability evaluation system from management supporting system, social satisfaction and systematic learning capability, early-warning system, processing system and recovery system, on the basis of balanced scorecard analysis framework and management system structure. Considering the effect of risk factors in campus emergency management capability, Ji, Su, Lv (2012) has established campus emergency management capability evaluation index system, which is based on organizational mechanism risk of emergency management, emergency preventive capability risk, emergency disposal capability risk and emergency recovery capability risk. There is relevant theoretical and scientific basis for the selection of index and framework logic. On the basis of comprehensive emergency management and conflict theory as the theoretical basis, this study gives a detailed account of the process of index selection and determined basis for each index. It also makes a contrast analysis of campus emergency management between countries and regions like the United States, Japan and Taiwan and China to find out the similarities and differences, improving and perfecting the campus emergency management capability index. Compared with the above research, the basis of the selection of this study is more explicit and its framework logic is clearer.

2) The construction of index system. Eileen and Stephanie, etc. (2011) have reviewed the literature on campus emergency plans and found that the unique needs of the campus environment fails to draw enough attention and the evaluation studies on the university campus emergencies just stays at an early stage, and

thus they established a model to assess campus management and reduce the threat. Borum and Cornell et al. (2010) think that as a very effective strategic approach, the threat assessment needs to be further studied, and later they outlines the campus needs, so as to prevent and reduce campus shootings and develop emergency planning for some crisis, so the research above mainly focuses on the index system for the prevention of emergency management. Jackson and Sullivan et al. (2011) have described the reliability analysis process of emergency response system and put forward an approach to evaluating the emergency response system with a case for verification, so it just focuses on the index system for the disposal of emergency management. Simpson and Katirai (2006) consider that it is feasible to measure the evaluation on the readiness to respond to disasters with indicators. They have proposed a set of disaster preparedness indexes to evaluate the preparation quality of disaster response, mainly for the index system establishment in the prevention and disposal of emergency management. An Australian scholar (2002) has established a emergency capability evaluation system from eight aspects such as preparedness measures, mitigation measures, emergency response measures, disaster risk assessment, disaster policy development, post-disaster assessment, short-term relief measures and long-term relief and restoration measures and he employs the system to study the advantages and disadvantages of emergency management measures that the Australian Government takes, mainly for the index system establishment in the prevention, disposal and recovery of emergency management. How and Tom (2006) just introduce an index system about disaster emergency capability assessment, mainly based on the index system in the emergency management process.

Henstra (2010) draws on relevant research literature to determine 30 elements of efficient local emergency management program and integrates these key elements into a frame, which provides a method for the evaluation and implementation of emergency management programs mainly based on the index system in the emergency management functions. Hen (2011) sets up an evaluation index system of campus emergency management capability based on the application of Hall Three Dimension Structure and analysis of time, logistics and knowledge mainly based on the index system in the emergency management capability factors. This study determines preliminary index system from the three dimensions, the emergency management process, functions and capability elements. We invite 12 experts for discussion to listen to their ideas and suggestions on the index system construction, thus constructing the campus emergency management capability index system in the preventive capability, disposal capability, recovery capability and learning capability. Compared with the above research, this study is more comprehensive and the construction dimension is more scientific in its content.

3) The determination of the index weight. Many scholars often use a single method to get the index weight, and for example, Chen (2011) uses the order relation analysis method to determine the index weight, and the expert score determines the value of each index. (Ji, Su, & Lv, 2012) construct the model by the AHP to evaluate the emergency management capability of campus emergency. The AHP is used in the study above to determine the weight of the index, but its application still has some problems in two aspects, and that is likely to cause inaccuracy of scaling and poor transitivity. In order to overcome them, this study has integrated the AHP method and

Entropy method to determine the index weight of campus emergency management capability. Based on the AHP method to determine the index weight, the weight can be corrected by Entropy method. The determination of the index weight of this study is consistent with the study of (Hu, Zhu, 2010).

4) The evaluation of emergency management. In the evaluation of emergency management capability in colleges and universities, many scholars use qualitative research, such as Jackson and Sullivan et al. (2011) who just describe the reliability analysis process of emergency response system. Hu and Zhu (2010) have made only a differential description of the emergency management capability of the case University. Because of the rich content of emergency management capability in universities and many indexes, it is difficult to carry out quantitative research. The evaluation of emergency management capability in the above colleges and universities is qualitative research. This study breaks the bottleneck of failing to use quantitative research on campus emergency management capability in previous researches, and uses fuzzy comprehensive evaluation method to turn evaluation model into the "ruler" measuring campus emergency management capability. The quantitative research empirically tests the effectiveness of case emergency management capability.

6.1.2 Index Weight Ranking and Causality Analysis

Through the weight analysis of every dimension, the weight of preventive capability is the highest, 0.3916; the second is disposal capability, 0.3273; the third is learning capability, 0.1632; the fourth is recovery capability, 0.1179. The results of the weight analysis in this study are in agreement with the results of the "The Blue Book of

Emergency Management--The Report on Emergency Management of China (2016)".

1) Preventive capability. The weight of organizational structure in this dimension is the highest, 0.3756. Representative scholars believe that a sound system of the organizational structure is the most important factor influencing preventive capability, so to enhance the capability of an emergency management institution. And therefore a sound framework with clear responsibilities and rational personnel should be set up. The second is the early risk warning and control with a weight value of 0.3164, so in the prevention, much attention should be paid to information collection and judgment, timely warning information and contingency plans to deal with emergencies. The third is the education training and drill with a weight value of 0.2093, so emergency training and drill should be organized according to the plan in the prevention to improve the emergency knowledge and skills of teachers and students. The fourth is funds and goods facilities index with a weight value of 0.0987, so emergency facilities should be strengthened in the prevention and more attention should be paid to emergency funds and material reserves in order to prepare for a rainy day.

2) Disposal capability. In this dimension, the index weight of emergency organization is the highest, a value of 0.4055, which indicates that scholars believe that the emergency organization is the key in the emergency disposal, so leadership and emergency personnel should respond quickly and organize the relevant departments and personnel to start emergency work, security emergency funds and supplies. The second is the emergency control index, a weight value of 0.3730, and therefore it is a must to immediately organize the evacuation and rescue in emergency

disposal, make dynamic assessment of damages and take corresponding measures to avoid the occurrence of secondary disasters. The third is the emergency command index, a weight value of 0.1213, so it is necessary for the emergency disposal to make a quick decision, then start early disposal according to the plan, and finally ensure the follow-up emergency disposal to be carried out. The fourth is emergency coordination index, a weight value of 0.1002, and thus in the emergency disposal, it also needs to timely collect and release the dynamic information of emergencies, coordinate the communication and cooperation with the emergency forces within and outside the school and jointly control the results of the damage.

3) Learning capability. In this dimension, the weight of case base study is the highest, 0.6448, which indicates that scholars believe that more attention should be paid to the collection of all kinds of incident cases, the construction of campus emergency case database, regular organization of emergency personnel's learning and exchange to improve the emergency management capability and level. Next is case study index, and the weight value is 0.3552. Learning also needs to systematically analyze and summarize the cause and disposal process of each event, learn from experience, draw lessons from it and avoid similar events happening again.

4) Recovery capability. In this dimension, the follow-up disposal has the highest weight value of 0.6991, showing that scholars believe that the first is to carry out the investigation of emergency events, assess damage results, and give full play to the role of warning and education by claiming accountability and disposal to person liable. The second is to restore the construction index, and the weight value is 0.3009,

which means to work out a recovery plan, rebuild damaged facilities system, and timely intervene and tutor people's psychological trauma.

The four dimensions-preventive capability, disposal capability, recovery capability and learning capability are all contents of campus emergency management capabilities. The disposal and recovery capability express in the process of the occurrence of unexpected events, passive rescue and disaster relief and recovery of emergency management, whose purpose is to minimize the damage, quickly eliminate the damage results and restore the original order. Preventive capability and learning capability is before and after the incident occurred, a process of initiative response and prevention, whose purpose is to prevent the occurrence of emergencies, avoid sudden incidents and minimize the possibility of emergencies. To sum up, the construction of campus emergency management capability should fully implement the principle of "prevention first" and focus on strengthening the preventive capability construction, and learning capability is to strengthen the preventive capability. Therefore, the construction of preventive and learning capability is the most important thing to improve the campus emergency management capability.

6.2 Countermeasure and Suggestions

As for the construction of campus emergency management capability, this paper puts forward countermeasures and suggestions in three aspects, namely, universities and colleges, competent departments and the future research.

6.2.1 Suggestions for the Colleges and Universities

Through the index analysis of campus emergency management capability and empirical analysis of Sample University, it is found that preventive capability and learning capability are both key contents and relatively weak aspects of campus emergency management capability. In order to improve campus emergency management capability, two key measures to be promoted are summed up in this paper, risk management and the archives platform construction. Moreover, for the disposal and recovery capability, the construction strategy is proposed from the perspective of emergency management mechanism and principle.

6.2.1.1 Using Risk Management to Strengthen the Preventive Capability

1) Risk and risk management

Risk Management is using some economic and technological means of risk identification, measurement and scientific decision-making to deal with risks, so as to avoid risks and minimize losses. With the development of risk management, designing safe mechanical systems and operation procedures to prevent or mitigate the loss of personnel and property caused by disasters and accidents has become an important function of risk management (Wu, 2017).

Risk management is a management process, which includes the determination, measurement and evaluation of risks as well as the development of strategies to deal with risk. It is aimed to minimize avoidable risks, damage and loss. Risk management originated in the United States and is a new management discipline. After 1938, American enterprises began to adopt scientific methods for risk management and

gradually accumulated rich experience. In 1950s, the development of risk management became a subject, and the word "risk management" was formed. After 1990s, the theory of risk management expanded gradually from the economic field to safety, social, national and other research aspects. It uses some means of risk monitoring, risk identification, risk quantification and risk intervention to intervene the management of various uncertain behaviors and events (Benoit & Luciano, 2007). According to the modern theory of risk management, the introduction of risk management into the prevention of campus emergency management and joint strengthening from risk management, education and training, plan establishment, resource reserves and other aspects can greatly improve and enhance emergency management capability.

In the current practical work to deal with campus emergencies, more attention is paid to recovery afterwards instead of prevention in advance, thus causing the lack of daily preparation for prevention, education and training, crisis drills and so on. In the research of campus emergency management, emergency disposal mechanism takes the majority of contents, and more focus on discussing the emergency plan is also made in the prevention, but less on effectively controlling the occurrence of emergencies. It should be noted that "campus emergencies are characterized with randomness, discreteness and small probability", which have brought large difficulties to the prevention. However, although campus emergencies are difficult to avoid, it is an important to reduce the frequency of campus emergencies or mitigate the hazards by usual management, and also an important means to actively respond to emergencies in colleges and universities.

2) Risk management process

The risk management of campus emergencies mainly include risk evaluation, classification, intervention and risk transfer for all kinds of emergencies(Neil & Sanford 2007). Risk monitoring evaluation and risk identification is the first step in risk management. Due to the variety and uncertainty of campus emergencies, monitoring and evaluation is cumbersome and difficult, but quite important. In the management, the complex treatment of simple things or the negligence of problems to be solved often brings a seemingly simple question into new problems we are unaware of. The root of the problem lies not in the complexity of potential risks, but the complexity of organizational structure and the neglect of problems found. Risk monitoring and evaluation is the basis of risk management. It must be carried out carefully and patiently, and the symptoms of any potential risk cannot be passed. The establishment of monitoring projects can be constantly improved in the course of risk management, and the task of monitoring and evaluation should also be divided for hierarchical management. Risk grading is a classification of the risks discovered, and it is through intervening high-risk events to reduce risks and prevent emergencies from happening. The grading standard can draw on the concept of risk degree in risk management and combine the two aspects of qualitative and quantitative. But for the irresistible risk, we should actively seek the way of risk transfer. For example, personal injury and natural disasters that may cause personal injury and natural disasters can cause losses, so an active part in commercial insurance should be taken to avoid risks.

3) Risk monitoring, evaluation and grading

According to the classification of campus emergencies, the risk monitoring and evaluation items should be set up for each emergency. However, there are many standards of classification to facilitate risk monitoring and evaluation, so campus emergencies are divided into six categories, terrorist attack incidents, campus crime emergencies, natural disasters, accidents emergency, public health and hygiene emergency and psychological problems emergency. In each general category, specific monitoring objects are set up. The specific evaluation contents and methods should be set separately according to the specific circumstances.

In the theory of risk, risk degree is the scale of measuring crisis and dangers. It is a function of the possibility of an event. The possibility of an event occurs between 0-1, which means that 1 is bound to happen, and 0 is impossible. If the number is 0.5, then the possibility is half (Siri, 2007). After collecting and sorting relevant information and data, the dynamic evaluation and grading of campus emergency risk can be carried out. Then according to the data and experience of determining the risk degree, campus emergency risk can be divided into large, medium and small or high, middle and low. The determination and grading of risk is a complex and difficult task. We need to accumulate relevant experience in practical work and try different methods in theoretical research and constantly accumulate and improve it. For those with less risk in the conclusion, we can continue to monitor the projects. And the larger risk projects should be intervened immediately so as to reduce the risk. After intervention, monitoring and reassessment should be made again until the risk falls to the controllable range.

4) Risk intervention and transfer

The intervention of high-risk events is the key point in the prevention of campus emergencies. So the intervention strategies should be formulated accordingly. In practices, colleges and universities have accumulated a lot of experience and methods. Every aspect of the method and theory is worthy of special research, which needs further exploration, research, innovation and continuous development and improvement. The intervention of risks cannot completely eliminate them, and in fact it is impossible to do that. The risk management theory believes that when the cost of intervention is greater than the loss, people will choose to accept the risk (Neil & Sanford, 2007). Special attention should be paid to the correct the scale of intervention. If the intervention is excessive, it can cause unnecessary tension and affect the normal teaching environment. Therefore, risk intervention should be bound by reducing the risk to an acceptable range.

Campus emergencies are inevitable because the risk cannot be completely eliminated. For irresistible risks, colleges and universities should initiatively seek ways to transfer them. There are few studies on risk transfer in the emergency management of colleges and universities, which should be actively discussed. The so-called risk transfer is to take part or all of the risk that he should undertake to someone else. The cost is to pay a certain fee or to give some kind of compensation. The risk transfer of campus emergencies refers to the transfer of the risk loss of emergencies to other organizations and units at a certain price.

The risk of campus emergencies is not all able to transfer, but there are also some risks that can be transferred. The most direct way to transfer risks is insurance. The risk of natural disasters, safety accidents and public health emergencies can be transferred

through commercial insurance. So the awareness of insurance in colleges and universities should be strengthened, and the relevant means should be actively used to transfer the risk. The ways to transfer risks still need further research, innovation and development. Risk transfer needs to pay a certain price, and there is no gratuitous risk acceptor. Therefore, colleges and universities should carry out appropriate cost accounting and transfer the irresistible risk when its cost is less than the cost of risk.

5) Risk management organization and implementation

The risk management organization of campus emergency should start from two aspects. One is to set up a standing body of emergency management team specialized within the jurisdiction of school-leveled emergency management team, responsible for the daily work, and therefore school organizations and units at all levels should actively participate in risk management. One of the most important functions of emergency management team is to prevent and prepare for emergencies prior to the occurrence of emergencies (Spillan, 2013).

The school-level emergency management team should establish a regularly special office and be equipped with full-time administrators, which can help the continuous and stable launching of all work. The risk management of emergencies in colleges and universities involves a lot of daily work. It is necessary to send a specially assigned person to report to the emergency management group regularly. For the execution of monitoring, evaluation and intervention of risks, the office should distribute them to other units. It is far from enough to rely solely on the work of emergency management team. We must strengthen cooperation and cooperation among various units,

implement the management objectives of various departments, form a comprehensive risk management network and formulate corresponding rewards and punishments. As the risk assessment and intervention, there involves a large number of professional knowledge and professional personnel, so the risk management of campus emergencies must pay attention to the establishment of professional teams. Special expert advisory groups are set up in the relevant fields, such as the health expert group, the mental health expert group, the legal expert group and so on. The emergency management team must know that what kind of technical support can be obtained from experts, and how to get these experts' support when needed.

A more perfect Total Risk Management (TRM) scheme is established, which emphasizes process orientation and environmental dependence, and manages the whole process of risk. So it needs to analyze and monitor the living environment of the organization and increase its flexibility (resource flexibility, system flexibility, culture flexibility, reaction flexibility etc.), which can enhance everyone in the organization to think and improve the organization's sensibility to external changes, rapidity and agility of correct response (Harriet & Jean, 2015). In the risk management process, superficial measures can only bring a passive management. Therefore, in the emergency management, we must actively strengthen the risk monitoring, evaluation, classification, intervention and transfer, implement the emergency management principles of "prevention first", and improve the consciousness of "checking erroneous ideas at the outset", so as to really play a role in the prevention of campus emergencies.

6.2.1.2 Using The Archival Platform to Strengthen Learning

Capability

This paper puts forward that the construction of campus emergency management archives platform is to sort out and file the cases, and its ultimate goal is to share learning case database in colleges and universities.

1) Campus archives platform construction

Case analysis and accumulation is an important part of campus emergency management. It can greatly enrich the knowledge of handling emergencies, summarize lessons from failures, and improve emergency management capabilities, which is worthy of great concern (Sidney & Magnus, 2008). Not only should cases of this school be collected, but also the related cases of other schools should be collected. So special files should be set up for these cases, and they should be arranged and organized by specially assigned person. The learning process of campus emergency management is divided into two links, case study and general study. A case study refers to the summary of causes analysis and disposal process of specific case, and the corresponding prevention and management experience etc.. Overall learning include the case collection and filing of different campus emergencies on and off campus and also classification, supplement, management and learning sharing of these archival resources. At present, the campus pays more attention to the case study, and the weak is to file and process all kinds of emergency cases in other colleges and universities.

The archival information learning of emergencies plays an important role in preventing and disposing of emergencies. At present, the types of emergencies in colleges and universities have been always refurbished, and the number of them has increased

dramatically, which is difficult to deal with only by experience. Therefore, schools should set up information and learning platform for campus emergencies to collect and sort out documents, summary reports, case studies and related information of campus emergencies. The important content of campus archives platform construction is the archiving, summarizing and learning of emergency case files, so as to improve the experience and skills of preventing and dealing with emergencies.

2) The construction of sharing archives platform

To realize the transmission and sharing of disposal information and archival materials in campus emergencies is of great significance for improving campus emergency management capability. The fundamental starting point is not to expose emergencies in universities, but to learn from them. Therefore, in the process of sharing archives platform construction, information transmission can delete personal and unit information and just provide information related to events for university learning and sharing (Liu & Zhang, 2009).

6.2.1.3 Strengthening Disposal Capability by Using Management Functions

1) Emergency organization. The establishment of emergency management institutions is the key to improving the emergency organization in colleges and universities. If there is no such institution, unexpected incidents can only be dealt with by school leaders. Although school leaders have the power to mobilize all the school resources, they are not experts in dealing with emergencies and lack of specialized knowledge and practical experience. Therefore, it is easy to take emergencies as

administrative affairs but ignore the causes and development law of emergencies themselves, which tends to miss best time to deal with unexpected events. The campus emergency management institution should be a permanent organization, mainly responsible for the coordination of daily emergencies, and corresponding emergency management posts vacancies, introducing professional personnel, providing regular emergency training to its members and improving the overall quality and ability of the emergency management team (Rhonda, 2007).

While establishing a permanent organization, a supporting pluralistic governance system and a mechanism should be set up. Specifically, secondary colleges should be divided into a number of management grids in accordance with the relevant departments of teaching, scientific research, students, logistics and personnel, and departments prone emergencies. Only by establishing this kind of emergency management grid structure and endowing it with corresponding autonomy, the dead and blind area in the management can be avoided, to improve the capability of emergency organization, so it is necessary to discover emergencies, do early warning and make early disposal.

2) Emergency command. After emergencies, we should quickly respond to emergency command, correctly analyze and make decisions, quickly control the situation, maintain the order and placate the emotions of teachers and students. The emergency command mainly depends on the composition of the decision-making experts, the implementation capability of the plan, the adjustment of the dynamic plan, the ability of material allocation and the integration of human resources (Tong, 2003). Among them,

the structure of decision-making experts requires campus to perfect the emergency plan and alternatives. The implementation capability requires campus to formulate a complete emergency contingency plan and do a detailed plan. The adjustment of the dynamic plan requires that colleges and universities make timely judgments and orders according to the evolution of emergencies. The allocation capability requires campus to increase the input of emergency supplies and establish an emergency linkage mechanism in colleges and universities. The capability to integrate human resources requires a complete set of emergency management posts and a well-trained personnel team.

3) Emergency coordination. Emergency coordination is mainly reflected in the capability of universities to coordinate the emergency response capabilities of the outside, and the basis of coordination is the collection and transmission of information (Du & Yang, 2008). Limited to geographical space, population concentration area, the transmission of information should be faster and more accurate. In terms of the diffusion and dissemination of external information in colleges and universities, to realize the guiding media, it is necessary to establish an unimpeded information channel and communicate with the media actively, to guide media public opinion, publish accurate information in time, make public opinion move in the right direction and maintain the image and reputation of the campus. In terms of coordination capability, some university leaders are not excluded to possess such capabilities of emergency coordination. However, as a result of limitations of the growth environment, leaders of colleges and universities are mostly academic and have not been trained in the capability of emergency coordination. In addition, the lack of exchange of administrative

resources in colleges and universities gives no compulsory administrative power. Therefore, when the emergency needs to be coordinated with the media, the police and the government department, it often appears to be hard to do. So the leaders of colleges and universities should strengthen the capability of emergency coordination. In the event of emergencies, they are good at coordinating the emergency disposal forces such as fire, police, health, media and other emergency disposal forces to form the joint force of emergency disposal.

4) Emergency control. It is mainly reflected in education, training and drills, risk analysis and hidden trouble investigation (Erland & Amund, 2006). Colleges and universities are often weak in education training and drillings. At present, the common educational model is the publicity of slogans and sketch boards. The content of education is limited to the use of electricity safety and traffic safety. The publicity is not wide enough and the content is not comprehensive enough, so the subject and form of education is just limited to the class teacher's meeting, not strong enough and profound into students' minds nor detailed, comprehensive and specific enough to convey the information. In the training, it is very wanting for both the emergency management staff and teachers and students in colleges and universities. Teaching staff in the school is lack of basic knowledge and skills to escape and deal with dangers while colleges and universities are often in the form of practice.

Therefore, the campus needs to increase the strength, breadth and depth of education and trainings, which should be held regularly. Trainings should be carried out to strengthen exchanges and summing up, and emergency drills should be taken regularly

to test response and disposal capability in emergencies. In addition, colleges and universities should strengthen the risk analysis and hidden trouble investigation, establish duty system and inspection and inspection management system, perfect the construction of information network, and form the mechanism of periodic inspection, examination and report.

6.2.1.4 Using the Responsibility Mechanism to Strengthen the Resilience

1) Follow-up work. Follow-up work consists of timely evaluation on the losses caused by campus emergencies as well as investigation for reasons and punishment to the relevant responsible person (Koliba & Mills, 2011). The loss caused by the sudden incidents is divided into direct loss and indirect loss. The direct loss mainly includes the tangible life and property loss and the indirect loss includes the invisible loss of school reputation, teachers and students' psychology and so on. The loss caused by emergencies should be evaluated scientifically, which lays a foundation for scientific restoration and reconstruction. The parties responsible for causing emergencies must be punished. It should not be hasty to act the responsibility but careful to make decisions before in the absence of clear facts. Penalties should be given in accordance with the relevant provisions in the universities, or relevant laws and regulations. For actions without breaking the legal responsibility, colleges and universities should respond in a timely manner according to their own situations. Acts of violating the law must be held accountable strictly in accordance with the provisions of the law. The units and individuals who have outstanding performance in handling emergencies should be

rewarded and be appreciated their contribution in the time of distress.

2) The recovery construction. According to the tangible and intangible losses caused by emergencies, the construction can be divided into the construction of facilities and equipment, reconstruction of teaching and management order, intangible reputation restoration and psychological counseling between teachers and students. For the reconstruction of facilities, teaching and campus management system, it is necessary to realize that the reconstruction is not simple restoration. The crisis is not just a danger but also means a favorable turn. The process of recovery and reconstruction must reflect the "favorable turn". That is to use the opportunity of the crisis to rationalize the existing unreasonable facilities and systems in order to prevent the occurrence of similar incidents.

Psychological counseling and assistance is also an important part of the construction of emergencies (Smith & Sandhu, 2004). The tragic scene of emergencies often leaves a shadow among teachers and students, which is difficult to eliminate for a long time. Emergencies may have different effects on people's psychology. One is that the parties can effectively cope with the crisis, so emergencies have no adverse psychological impact on them. Another parties can survive the crisis, but their hearts are still engraved in the shadow of the crisis, and then the adverse consequences of the crisis will often manifest later in their lives. Actually the third kind of people has already had mental collapse at the beginning of the crisis. The first is the most ideal state, but also our pursuit of the goal. The second and third, is the negative impact of unexpected events on people's psychology, but the degree is different, which performs as the parties" panic,

anxiety, fear and helplessness. A lot of psychological researches show that excessive panic, anxiety, restlessness, nervousness and excessive fear can weaken the body's resistance, reduce the psychological immunity to be more prone to illness and even lead to irrational behavior, posing a threat to social stability and order. If the parties cannot get timely psychological adjustment and balance in the event of an emergency, they will be hard to cope with various pressures and show bad behaviors such as escaping, being autistic and impetuous and even evolve into serious psychological problems. Therefore, colleges and universities should pay more attention to the psychological guidance and assistance to teachers and students. This psychological help can be carried out individually or in groups, face to face, or by telephone or media.

6.2.2 Suggestions for the Competent Department in Colleges and Universities

At present, universities often keep mutual independence and fight separately in response to emergencies, without establishing an orderly and organized linkage mechanism. Especially in the face of natural disasters, public health and other emergencies, it is difficult to achieve mutual assistance, joint decision-making and unified action to respond to emergencies among universities. To solve this problem, we need leaders to take the lead in building up an emergency linkage mechanism among universities, so as to achieve resource sharing and form a joint decision-making and unified action for colleges and universities to cope with emergencies. This article holds that the establishment of the emergency linkage mechanism of the competent departments mainly includes the following four aspects.

1) Establishing emergency linkage agency

The first step to establish linkage mechanism is to set up an emergency response command center. The competent authorities in colleges and universities can choose universities located in the central area and establish emergency response command centers. To ensure that after the occurrence of emergency, the emergency command center should start quickly, make unified decisions, and communicate with the government, media and social rescue forces quickly, coordinate and link up, and cooperate to prevent and deal with emergencies (Waugh & William, 2006). As a unified command and dispatch emergency command center, the university will not have too much anxiety in making decisions or take measures as aggressive or conservative, but can make decision more in line with the emergency situation. Even in the case of unclear instructions of the government, the emergency linkage mechanism can make scientific decisions quickly to realize the sharing of liability and slow down psychological pressure by the various campus emergency management agencies, which helps the university take time for emergencies and reduce the damage and loss caused by emergencies.

2) Sharing emergency materials

The campus competent departments can establish an emergency material sharing mechanism to realize the sharing of emergency materials among colleges and universities according to the situation of emergency materials reserve (Hilyard,2010). Separate campus emergency material reserves alone not only consume a lot of funds, but also require a lot of storage space. The administrative department can guide various colleges and universities to reserve one kind of emergency material as much as possible

instead of all emergency supplies when they begin to prepare basic emergency supplies. The administrative departments establish emergency supplies sharing mechanism in which colleges and universities can share other supplies in addition to allocating basic necessities in their own schools when emergencies, to ensure the full protection of emergency supplies in the school and adjacent universities and improve the utilization efficiency of emergency materials.

3) Establishing information channel

Considering the school's reputation and influence, colleges and universities are not willing to actively communicate emergencies with other campus, which seriously hinders the communication of information between colleges and universities and hinders the improvement of capability to deal with emergencies through experience learning and exchange. Thus, it requires the establishment of information channels by the competent departments of colleges and universities, and coordinates the joint research and formulation of coping strategies and preventive measures. The establishments of campus information channels can provide timely information for universities unaware of dangers and do prevention ahead of time, to avoid some emergencies happen repeatedly in different universities (Wu, 2005).

4) Setting up a sharing archival platform

The experience of coping with emergencies in colleges and universities is worth learning for all campuses whether or not successful. By sharing archives platform in universities, we can learn from the experience of preventing and disposing of emergencies, and enhance the common cognition of emergencies in various colleges and

universities (Moore, 2009). In view of the fact that the construction and operation of archives platform needs more manpower and capital investment, therefore, the competent departments shall take the investment and meanwhile the sharing platform archives center should be set up in the administrative department, responsible for information collection, organization and sharing of resources for campus emergency management.

In summary, the authorities can take the principle of proximity, and establish emergency linkage mechanism of campus emergencies according to different regions. The lead unit can be in the charge of regional universities in turn, and the daily coordination agency can be set up in the lead universities, responsible for emergency information exchange and data sharing and learning. When an emergency occurs in a university, the leading university can call leaders in charge of colleges and universities together in this region to invite the leader of the administrative department for the joint discussion of coping strategies, coordinate their work, share emergency materials, and initiate an emergency response mechanism.

6.2.3 Suggestions for the Future Research

1) Empirically evaluating the membership of each index of campus emergency management capability, and putting forward the strategy and suggestions for each index through field investigation.

2) Conducting research on the performance of emergency management in colleges and universities. On one hand, it effectively strengthens emergency management capability, and on the other hand, it can help study how to make this capability produce high performance in practice.

3) Strengthening the mitigation, reduction and preventive study of the classification risk in campus emergencies, so as to help create more significant achievements in the emergency management, minimize the harm of various emergencies, and keep the countermeasures more specific, feasible, and operable.

6.3 Research Contribution

This paper explores the campus emergency management capabilities from three parts. As shown in Table 6-1.

Table 6-1 The Main Research Findings

Issues	The main findings of this study
Establishing a campus emergency management capability index system.	Integrating capability process analysis, management functions analysis and capability elements analysis of campus emergency management to form the three-dimensional structure model of campus emergency management capability, a capability index system, including 4 first-grade indexes, 12 second-grade indexes and 36 third-grade indexes. See Table 4-2.
Building up an evaluation model of campus emergency management capability.	The combined use of AHP and Entropy method to determine the weights of the index system helps the construction of campus emergency management capability evaluation model. See Table 4-38.
Using the evaluation model to test the emergency management capability.	In this study, the index membership shown in Table 5-4 is used to make empirical analysis of three different types of colleges and universities , and thus corresponding results are obtained, and the suggestions for emergency management are put forward.

This research is a pioneering systematic study of campus emergency management effectiveness, which is characterized by a comprehensive and systematic analysis of campus emergency management capability evaluation. The main research findings include the following three aspects.

1) It breaks the previous research concept of testing campus emergency management capability only from the single dimension of management process or function. This paper integrates three dimensions of management process, functions and capability elements to set up a connotation structure model of campus emergency management capability and on this basis, the corresponding index system is established.

2) After a lot of interviews, measurement standards of the index system is clearly defined, it avoids shortcomings and deficiencies of inaccurate scaling and poor transitivity by only using AHP to determine the index weight in the previous studies, and the combined use of AHP and Entropy method to determine the weights of the index system helps the construction of campus emergency management capability evaluation model.

3) It breaks the bottleneck in previous researches on campus emergency management capability for quantitative research. This paper uses fuzzy comprehensive evaluation method to transform the evaluation model into a ruler measuring campus emergency management capability, empirically testing the effectiveness of emergency management capability in case, accurately checking out short board and the insufficiency existing in the case campus emergency management capability, and targetedly putting forward countermeasures to enhance the campus emergency management capability.

6.4 Research Limits

Campus emergency management is a relatively new and unique research field. The above conclusion shows that research on campus emergency management capability is of great importance both in theory and practice. However, there are still some difficulties in this study that need further study.

1) Due to resource and geographical constraints, empirical evaluation on each type of university fails to be carried out. In future research, we hope to continue to expand the scope of evaluation.

2) Due to time and authority limitation, suggestions to improve have not been applied to campus emergency management practice to create emergency management performance.

3) Due to that the criterion validity is the quantitative analysis and comparison of tested objects, it is more objective than the content validity, and its significance is more intuitive and easy to be understood and accepted. Therefore, validity tests in the structure and criterion are conducted for the validity analysis of this forecast questionnaire, not verified any more by the experts.

In conclusion, with the deepening of research, it can be found that more and more contents deserve to be studied and this paper just makes a preliminary exploration in this field. In the coming future, we expect to continue in-depth research on what is limited in this paper.

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APPENDICES

APPENDIX 1

Interview Outline of University Emergency Management Capability Index

1. Interview description

1) According to your work experience, please give the first answer to the following questions, which will make the interview more scientific.

2) The interviewer will explain relevant items for you and record your answers.

3) The interviewers will involve a thorough understanding in your professional fields but will not address sensitive topics.

4) The total time is controlled within about 30 minutes.

2. Two interview content

1) Do you think it necessary for colleges and universities to strengthen capacity building for emergency management? What are the main aspects of campus emergency management capability?

2) Do you think the prevention of emergencies is important? Does the prevention of emergencies belong to the main content of campus emergency management capability? If so, what aspects should we focus on in the prevention of emergencies?

3) Do you think the emergency disposal process should focus on what? What indexes can be used to measure and evaluate the emergency response capability?

4) Do you think that the recovery capability should be incorporated into the campus emergency management capability? If so, what should be done to restore construction after an emergency?

5) Do you think it is necessary to sum up the experience and lessons after emergencies? How to summarize the learning can be beneficial to improve campus emergency management capability?

6) Do you think it necessary to collect other typical cases of emergencies in colleges and universities, and what are the good ways and means?

7) Combined with your experience in emergency management, in addition to the above, how can you measure and evaluate campus emergency management capability?

APPENDIX 2

Comparative Questionnaire of Campus Emergency Management Capability Evaluation Index

Dear Madam / Sir

Thank you for taking the time to participate in our survey. This investigation is about the research on the importance of different factors affecting the campus emergency management capability and it tries to apply the analytic hierarchy process (AHP) to establish the evaluation system of campus emergency management capability, so that we can seek scientific methods to improve campus emergency management capability. The questionnaire is fully used for scientific research, and your answer will be completely confidential. Please answer it carefully according to the actual situation and give your true opinion in the questionnaire. Your answer is very important to our research conclusion. Thank you for your participation!

1. Personal information (please tick in suitable option)

1) Your gender ① male ② female

2) your age ① under 30 ② 31-40 ③ 41-50 ④ above 50

3) Your institution ① government ② colleges and universities ③ else

4) Your education ① specialist ② bachelor ③ master ④ doctor and above

2. Subject Information. (This questionnaire requires you to assign specific points according to your actual situation and experience, please fill the corresponding score in the blank.)

Table 1 The Scale of The Importance

Scale	Implication
1	i,j, the two indexes are equally important
I=3,5,7,9	The index i is more slight, obvious, strong than the index j and extremely important
I=2,4,6,8	The above two adjacent judgment median
I=1/3,1/5,1/7,1/9	The index j is more slight, obvious, strong than the index i and extremely important

Table 2 Pairwise Comparison Evaluation of First-grade Index

A_i \ A_j	Preventive capability index	Disposal capability index	Recovery capability index	Learning capability index
Preventive capability index				
Disposal capability index	/	1		
Recovery capability index	/	/	1	
Learning capability index	/	/	/	1

Table 3 Preventive Capability Index Evaluation

B_i \ B_j	Organizational structure	Risk warning and control	Educational training and drill	Funds supplies facilities
Organizational structure	1			
Risk warning and control	/	1		
Educational training and drill	/	/	1	
Funds supplies facilities	/	/	/	1

Table 4 Disposal Capability Index Evaluation

B_i \ B_j	Emergency organizing	Emergency commanding	Emergency coordinating	Emergency controlling
Emergency organizing	1			
Emergency commanding	/	1		
Emergency coordinating	/	/	1	
Emergency controlling	/	/	/	1

Table 5 Recovery Capability Index Evaluation

B_i \ B_j	Post-emergency disposal	Recovery construction
Post-emergency disposal	1	
Recovery construction	/	1

Table 6 Learning Capability Index Evaluation

B_i \ B_j	Case study	Case base study
Case study	1	
Case base study	/	1

Table 7 Preventive Capability - Organizational Structure Index Evaluation

C_i \ C_j	Organization structuring	Assignment of responsibility	Emergency personnel's proportion and quality	Experts team building
Organization structuring	1			
Assignment of responsibility	/	1		
Emergency personnel's proportion and quality	/	/	1	
Experts team building	/	/	/	1

Table 8 Preventive Capability - Risk Warning and Control Index Evaluation

C_i \ C_j	Contingency plan making	Risk information collection and study	early-warning implementation
Contingency plan making	1		
Risk information collection and study	/	1	
early-warning implementation	/	/	1

Table 9 Preventive Capability - Educational Training and Drill Index Evaluation

C_i \ C_j	Educational training and drill	Emergency education training	Emergency drill implementation
Educational training and drill	1		
Emergency education training	/	1	

Emergency drill implementation	/	/	1

Table 10 Preventive Capability - Funds and Materials Facilities Index Evaluation

C_i \ C_j	Emergency funds guarantee	Emergency material reserves	Safety facilities and equipment
Emergency funds guarantee	1		
Emergency material reserves	/	1	
Safety facilities and equipment	/	/	1

Table 11 Disposal Capability - Emergency Organization Index Evaluation

C_i \ C_j	Leading organs	Personnel response
Leading organs	1	
Personnel response	/	1

Table 12 Disposal Capability - Emergency Command Index Evaluation

C_i \ C_j	Early disposal	Urgent decision	Contingency plan launching and implementation
Early disposal	1		
Urgent decision	/	1	
Contingency plan launching and implementation	/	/	1

Table 13 Disposal Capability - Emergency Coordination Index Evaluation

C_i \ C_j	Information collection, transmission and release	Materials supply	Personnel communication and coordination on campus	Joint coordination with emergency force off campus
Information collection, transmission and releasing	1			
Materials supply	/	1		
Personnel communication and coordination on campus	/	/	1	
Joint coordination with emergency force off campus	/	/	/	1

Table 14 Disposal Capability - Emergency Control Index Evaluation

C_i \ C_j	Evacuation and rescue	Damage control measures	dynamic evaluation on damage
Evacuation and rescue	1		
Damage control measures	/	1	
dynamic evaluation on damage	/	/	1

Table 15 Recovery Capability - Post-emergency Disposal Index Evaluation

C_i \ C_j	Event investigation and evaluation	Accountability disposal
Event investigation and evaluation	1	
Accountability disposal	/	1

Table 16 Recovery Capability - Recovery Construction Index Evaluation

C_i \ C_j	Recovery construction plan	Facilities and system reconstruction	Psychological intervention and coaching
Recovery construction plan	1		
Facilities and system reconstruction	/	1	
Psychological intervention and coaching	/	/	1

Table 17 Learning Capability - Case Study Index Evaluation

Ci \ Cj	Analysis of causes	Conclusion of disposal process	Organizing experience learning
Analysis of causes	1		
Conclusion of disposal process	/	1	
Organizing experience learning	/	/	1

Table 18 Learning Capability - Case Base Study Index Evaluation

Ci \ Cj	Cases collection and summarization	Case base construction and management	Case study and information sharing
Cases collection and summarization	1		
Case base construction and management	/	1	
Case study and information sharing	/	/	1

APPENDIX 3

Campus Emergency Management Capability Index Importance Score Table

Introduction. According to the number of the indexes in the same grade, the corresponding scores are filled based on the importance (The greater the score is, the more important the index is, and vice versa). Among them, the four first-grade indexes respectively correspond to the scores as 4,3,2,1. The 4 second-grade indexes of the preventive capability respectively correspond to the scores as 4,3,2,1. The four second-grade indexes of the disposal capability respectively correspond to the scores as 4,3,2,1. And the 2 second-grade indexes of the recovery capability respectively correspond to the score as 2,1. And the 2 second-grade indexes of learning capability corresponds to the score as 2,1.

The first grade index A	scores	The second grade index B	scores
Preventive capability Index A1		Organizational structure B1	
		Information early-warning B2	
		Educational training and drill B3	
		Funds, materials and facilities B4	
Disposal capability index A2		Emergency organizing B5	
		Emergency commanding B6	
		Emergency coordinatingB7	
		Emergency controlling B8	
Recovery capability index A3		Post-emergency disposal B9	
		Recovery construction B10	
Learning capability Index A4		Case study B11	
		Case base study B12	

APPENDIX 4

Campus Emergency Management Capability Index Evaluation Questionnaire

Dear Madam / Sir

Thank you for taking the time to participate in our survey. This investigation is a special subject research on campus emergency management capability and tries to make an analysis of the findings with the method of fuzzy comprehensive evaluation. All the answers in your questionnaire are anonymous without the differences of being right or wrong. The result of the questionnaire is used only for statistical analysis. For your personal information, we shall keep secret, so answers will not have any adverse impact on yourself.

Next, we need you to take a few minutes to answer these questions, so please give your answers carefully and express your true ideas. For statistical analysis, do not omit any question. Thank you for your participation!

1. Personal information (please tick in suitable option and give a reply if there is no option)

1) Your gender ① male ② female

2) Your age ① under 30 ② 31-40 ③ 41-50 ④ above 50

3) Your position ① leader ② administrative staff ③ staff

4) Your education ① specialist ② bachelor ③ master ④ doctor and above

2. Subject information (Please answer the following questions according to your understanding, please tick under the closest grade)

Introduction, according to the evaluation standard, please evaluate the actual grade of each index of your school emergency management capability. The evaluation adopts five-grade scoring system, which can be chosen according to their own understanding, 5-excellent, 4-good, 3-medium, 2-qualified, 1-unqualified.

The First-grade index	The Second –grade index	The third –grade Index	Evaluation standard	Grade				
				5	4	3	2	1
Preventive capability index A1	Organizational agencies B1	Organization structuring C1	Establishing scientific and reasonable campus emergency management organization					
		Assignment of responsibility C2	Clear responsibility and reasonable assignment					
		Emergency personnel's proportion and quality C3	Proper proportion of professional emergency personnel					
		Experts team building C4	Build up a campus emergency experts team					
	Risk early-warning	Contingency plan making C5	There is operational campus contingency plan					

The First-grade index	The Second –grade index	The third –grade Index	Evaluation standard	Grade				
				5	4	3	2	1
	and control B2	Risk information collection and study C6	Collect and study potential risk information					
		Early warning implementation C7	Setting up reasonable institutions and schemes for campus emergency early warning implementation					
	Educational training and drill B3	Educational training and drill C8	There is scientific and reasonable education training and drilling of plan of campus emergency					
		Emergency education training C9	Regularly organizing and carrying out emergency education training with reasonable content					
		Emergency drill implementation C10	Regularly organize and enforce emergency drill with proper content, scale and scope					
	Funds materials and facilities B4	Emergency funds guarantee C11	Necessary emergency funds budget and input					
		Emergency material reserves reserves C12	There should be necessary emergency supplies reserves					
		Safety facilities and equipment C13	Emergency facilities and devices are well-equipped and their functions are sound and effective					
Disposal capability	Emergency organization B5	Leading organs C14	Establishing a reasonable campus emergency leading organs					

The First-grade index	The Second –grade index	The third –grade Index	Evaluation standard	Grade				
				5	4	3	2	1
index A2		Personnel response C15	In the face of emergencies, starting emergency systems according to procedures timely and effective					
	Emergency command B6	Early disposal C16	Early emergency disposal should be quickly ready with proper and comprehensive ways correspondingly in the face of emergencies					
		Urgent decision C17	Urgently make decisions to respond emergencies					
		Contingency plan launching and implementation C18	Launch and implement corresponding emergency plan according to emergency grades,					
	Emergency coordination B7	Information collection, transmission and releasing C19	The emergency management personnel should collect dynamic information of emergencies timely and release it comprehensively and precisely					
		Materials supply C20	In the emergency disposal, guarantee emergency supplies with high efficiency.					
		Personnel communication and coordination on campus C21	Timely communicate with supporting institutions and personnel on campus and coordinate to dispose emergencies					
		Joint coordination with emergency force off campus C22	Timely communicate with supporting institutions and personnel off campus and coordinate to dispose emergencies					
	Emergency	Evacuation and rescue	Timely and orderly evacuate the crowd and do					

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				5	4	3	2	1
	control B8	C23	effective rescue to the wounded					
		Damage control measures C24	Take effective control measures to avoid escalation and the occurrence of secondary disaster.					
		dynamic evaluation on damage C25	Make evaluation dynamically and scientifically on the damage caused by emergencies					
Recovery capability index A3	Post-emergency disposal B9	Event investigation and evaluation C26	After the events, carry out investigation and draw lessons to make up defects and deficiencies in the emergency management					
		Accountability treatment C27	Strictly investigate and affix legal liability according to accountability system					
	Recovery construction B10	Recovery plan C28	Establishing recovery and reconstruction teams to formulate scientific, reasonable and feasible recovery plan					
		Facilities and system reconstruction C29	quickly recover basic facilities and associated equipment to guarantee normal orders in the universities					
		Psychological intervention and coaching C30	Set up a counseling department to relieve psychological mental pressure and trauma of psychologically fragile people the weak with professional knowledge and skills					
Learning capability index	Case study B11	Analysis of causes C31	Carry out causal investigation seriously, make a comprehensive and accurate analysis of the causes and learn from the cases to avoid similar					

The First-grade index	The Second –grade index	The third –grade Index	Evaluation standard	Grade				
				5	4	3	2	1
A4			occurrence.					
		Conclusion of disposal process C32	Summarize the disposal process objectively and comprehensively, and find out existing problems and deficiencies in the disposal so as to improve and upgrade.					
		Experience learning C33	Sort out and collate good practices and disposal experience in response to emergencies and arrange relevant personnel to study					
	Case base study B12	Cases collection and summarization C34	Collect all kinds of cases on campus and typical cases off campus, summarize the prevention measures and experience in all kinds of cases					
		Case base construction and management C35	Emphasize the construction of emergencies the case base and it's better to have specially-assigned person responsible for classification, statistics and analysis, compilation of case learning materials					
		Case study and information sharing C36	Organizing personnel to learn, enhance teachers and students' prevention awareness, sharing cases prevention and countermeasures with other colleges and universities					