STUDY ON CAMPUS EMERGENCY MANAGEMENT CAPABILITY EVALUATION

Ao-Hong Guo[1], **Chia-Ching Tu**[2]

[1]Doctoral Candidate in Education Management at the China-ASEAN International College, Dhurakij Pundit University, THAILAND; Lecturer, Chongqing University of Science and Technology, Shapingba District, Chongqing, CHINA;
[2]Department of Educational Management, CHINA-ASEAN International College, Dhurakij Pundit University, THAILAND.

chia-ching.tu@dpu.ac.th; liou0929@yahoo.com.tw

ABSTRACT

The promotion of emergency management capability is the important contents of campus management. Based on the discussion of index selection, model establishment and weight determination of campus emergency management capability evaluation system, this paper researches such a system including its establishment and evaluation standard, and uses the AHP method and entropy method to determine the index weight of campus emergency management capability evaluation, providing a direction and guide for the construction of campus emergency management capability

Keywords: Campus emergency management, Index system, Weight, Evaluation

INTRODUCTION

So far, terror and violence incidence have become increasingly worse around the world and some terrorist activities like Al Qaeda and IS extremist organization are also getting rampant. 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; since 2015, there had been 45 different scaled campus shootings, nearly half inside colleges and universities. And some statistics showed about 9000 people were killed(www.guancha.cn, 2015). 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 (www.xinhuanet.com, 2008). Over recent years, all kinds of campus emergencies tend to happen frequently so the improvement of emergency management capability has become an important part of campus management. In order to further enhance this capability and perfect the relevant system, the evaluation of the existing emergency management capability is particularly important, for only through the evaluation the basic situation and shortcomings as well as weaknesses of campus emergency management can be well known, which helps to strengthen the construction of emergency management capability. By reviewing the existing literatures, it can be found that the scholars have made active explorations in campus emergency management capability evaluation and established different evaluation models, but there are still some problems in the incompleteness of index system and inaccurateness of index weight. For example: Eileen and Stephanie et al(2011) reviewed the literature on campus emergency plans and established the model of evaluating campus management and reducing campus threats; Henstra(2010) referred relevant research literatures; then he determined 30 elements of local campus emergency management program integrated these key elements into a framework, providing a method for evaluation and implementation of this program; Jackson and Sullivan et al(2011) described the process of reliability analysis for emergency response system and put forward the evaluation method to further confirm it by some cases. Weike Zhang, Liying Zhang(2011) established the evaluation index system of campus emergency management capability and determined the index weight by order relation analysis according to the analysis of the three dimensions: time, logic and knowledge. On the basis of the analysis framework of Balanced Scorecard, Xiaopeng Zhang(2011) built up the university emergency management capability evaluation system, and used the entropy method and the CTRIC method to determine the weights.

Conceptual research on campus emergency

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 two aspects: one is negative impacts, and another is 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 unforecastable, but it does not mean not be 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 an object of crisis management, an emergency inevitably has 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 or in the strict sense not only contains emergencies, but also incidents in overall sense, not all necessarily happen suddenly with negative effects and serious consequences. Then it can be determined that an emergency is actually a crisis occurs suddenly. The relationship between them can be seen in the following figure.

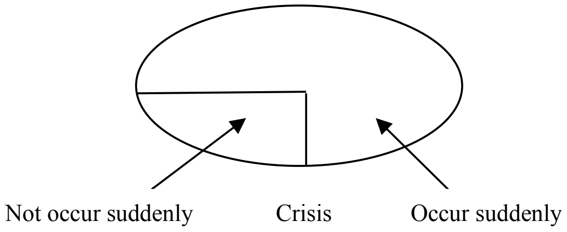

Figure 1. Relationship between Emergencies and Crisis

Therefore, campus emergencies can be defined as follows: an event happens suddenly on or off campus and is quite connected to someone or something in colleges; it may have serious adverse effects on the universities and colleges or even society and needs to take emergency measures to cope with.

Conceptual research on Campus Emergency Management

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(Reddick, & Christopher, 2011).

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.

The Campus Emergency Management Capability Index System

The construction of Campus Emergency Management Capability Index System

Campus emergency management capability evaluation is a systematic work, and scientific selection of indexes is the basic guarantee of the evaluation. Based on the literature review and combined with the characteristics of campus emergencies, this paper has initially established indexes from three dimensions, namely, emergency management process, functions and capability elements and made amendments and improvements by experts. Meanwhile, it uses the analytic hierarchy process (AHP) to establish a hierarchical structure index system. The hierarchy of indexes can be divided into four categories: (O) target layer (A) 4 first-grade indexes; (B) 12 second -grade indexes; (C) 36 third-grade indexes. As shown in table 2.

STANDARDS FOR CAMPUS EMERGENCY MANAGEMENT CAPABILITY EVALUATION INDEX

Preventative capability index

A. *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 (Edwards, Frances L., & Daniel C. Goodrich,2007).

B. *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 (Moore S, & Wallington T, 2009).

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

C. *Education training and exercises*

a. Standard for evaluation on training and exercise plan: whether campus emergency education training and exercise plan is made and its reasonableness.

b. Standard for evaluation on emergency education training: whether emergency exercise is regularly organized and its content, scale and scope.

D. *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 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 equipments on campus and they are adequate and in good condition.

Disposal capability index

A. *Emergency organization*

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.

B. *Emergency command*

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.

C. *Emergency coordination*

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; 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.

D. *Emergency control*

a. Standard for evaluation on evacuation and rescue: whether there is prompt and orderly evacuation; whether there is effective rescue for the injured.

b. Standard for evaluation on control measures: whether control measures are prompt, comprehensive and effective; 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.

Recovery capability index

A. *Post-emergency disposal*

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; 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; whether responsibility processing is objective, impartial and reasonable (Koliba, C. J., Mills, R. M., & Zia, 2011).

B. *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 (Smith, D. C., & Sandhu, D. S, 2014).

Learning ability Index

A. *Case study*

a. Standard for evaluation on cause analysis of events: whether an investigation is carefully carried out on event causes; whether a comprehensive and accurate analysis of event causes is made to learn the lessons and try so as to avoid similar events (Rebecca Bondu, & Herbert Scheithauer ,2013).

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

B. *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; whether prevention and disposal measures of all kinds of cases are summarized and comprehensiveness of collection and arrangement (Wei Liu, & Wanhong Zhang,2009).

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; whether prevention measures and countermeasures of all kinds of cases are shared and communicated as well as reasonableness of information collection and sharing.

Determining Index Weight of Campus Emergency Management Capability Evaluation

Determining index weight by analytic hierarchy process (AHP)

The analytic hierarchy process (AHP) is a qualitative &amp; quantitative combined, systematic and hierarchical analysis method, put forward by the operational research expert T.L.Saaty (W. Ho, X.W. Xu, & D.K. Dey, 2010). The details are like this: first of all, constructing judgment matrix according to the subordination between upper-lower indexes in table 1; secondly, inviting experts to make pairwise comparison on the importance among the indexes according to the proportion of 1-9 scale stratification; finally, calculating the weight vector of all indexes by using ANC, and testing the consistency.

Constructing judgment matrix

Due to the same weight distribution of each index, we take M expert first-grade index score (i.e.: prevention capability, disposal capability, recovery capability and learning ability are expressed as A1, A2, A3, A4) as an example to calculate the index weight.

$$A=\begin{pmatrix} 1 & 1 & 5 & 2 \\ 1 & 1 & 5 & 2 \\ 1/5 & 1/5 & 1 & 1/3 \\ 1/2 & 1/2 & 3 & 1 \end{pmatrix} \qquad (1)$$

$\lambda_{\max}=4.0042$, similarly, other judgment matrices and eigenvalues can be derived.

Calculating weight vectors. Weight vectors corresponding to the judgment matrix is calculated by ANC.

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

Consistency Test

According to the maximum eigenvalue of the judgment matrix, the consistency test of C.I.=0.0014，C.R.=0.0015is obtained. In the same way, indexes in all grades confirm to the consistency test. The first-grade index weights of campus emergency management capability are sorted as follows: $\overline{W_{A1}}=\overline{W_{A2}}>\overline{W_{A4}}>\overline{W_{A3}}$.

Similarly, calculating 12 second-grade indexes for B1-B12 which are subject to their respective judgment matrix (Ai-B) of the first-grade index Ai , 36 third-grade indexes for C1-C36 which are subject to their respective judgment matrix (Bj-C) of second-grade index Bj and doing consistency test to get the weight and test index. All C.R. are less than 0.1, so the M expert's judgment matrix in each grade has good consistency.

Amending Index Weights with Entropy Method

Guoqing Huang, Mingxu Wang and Guoliang Wang(2012) pointed out that in the analytic hierarchy process (AHP), expert scoring will inevitably lead to poor transitivity or inaccuracy of the scale. Therefore, in order to make the emergency management capability index weight more objective and reliable, it is necessary to amend the weight calculated by AHP, with the method of entropy. Entropy method is a research method proposed by German physicist Rudolf Julius Emanuel Clausius(Sha Fu, Zhongli Liu, & Guang Sun, 2015). Calculating the entropy can judge the degree of dispersion of an index: the greater the degree of dispersion of the index shows, the greater the impact of the index on the comprehensive evaluation (weight) is and the smaller the entropy value becomes. The entropy method is used to correct the index, which can reflect the utility value of the index information entropy, and express the idea of subjective and objective combination, making the evaluation system more scientific and reasonable.

Collecting Data and Constructing Judgment Matrix

Taking M expert as an example and using the entropy method to amend weights of the evaluation index system。

$$A = \begin{pmatrix} x_{11} & .. & x_{1m} \\ .. & .. & .. \\ x_{n1} & .. & x_{nm} \end{pmatrix}_{n \times m} \qquad (2)$$

Including x_{ij} *is the numerical value* p_{ij} *of the j-th index in the i-th plan..*

Calculating the Entropy of the j-th index.

$$e_j = -k\sum_{i=1}^{n} p_{ij}\ln(p_{ij}) \qquad \text{including,} \quad k > 0,\ \ k = 1/\ln(n),\ \ e_j \geq 0 ,$$

and $$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}} \qquad (i = 1,2,\ldots,n;\ \ j = 1,2,\ldots,m) \qquad (3)$$

Calculating the coefficient of variation of the j-th. For the j-th index, the greater the difference of the index value is, the greater the impact on the evaluation is and the smaller the entropy is. Difference coefficient g_j *:*

$$E_e = \sum_{j=1}^{m} e_j \ \text{including,} \quad g_j = \frac{1-e_j}{m-E_e} \qquad (4)$$

Calculating the weight coefficient of the evaluation index μ_j *:*

$$\mu_j = \frac{g_j}{\sum_{j=1}^{m} g_j} \qquad (5)$$

Using *entropy method to calculate the weight coefficient* μ_j *,amending the index weight coefficient* ω_j *calculated by AHP, and then getting an objective index weight coefficient* λ_j *.*

$$\lambda_j = \frac{\mu_j \omega_j}{\sum_{j=1}^{n} \mu_j \omega_j} \qquad (6)$$

In this paper 30 experts are selected for investigation and sampling, including 24 university experts, the 3 government experts and 3 business experts, and gets 28 valid questionnaires. Through calculation and consistency test, there are 4 not passing while the other 24 valid questionnaires are calculated their average weights, and finally the comprehensive weight of campus emergency management capability evaluation index system is obtained, as shown in table 2.

CAMPUS EMERGENCY MANAGEMENT CAPABILITY EVALUATION

Chen, (2014) mentioned that the evaluation on things from many aspects is inevitably with fuzziness and subjectivity, so using the "fuzzy transformation principle" in fuzzy mathematics to make a comprehensive evaluation can give more objective results. Campus emergency management capability evaluation involves a lot of indexes and different importance. Therefore, this paper uses fuzzy comprehensive evaluation method put forward by an American Professor L.A.Zadeh in 1965 to build up an evaluation model and analyze the actual level of each index through the questionnaire survey according to different attributes(Hongyu Wang, & Chaoyang Liu. 2016), thus providing decision-making basis for the construction of campus emergency management capability. Let’s take campus A as an example to evaluate the degree of excellence of its index system.

Determining the Set of Judgments

Setting five grades evaluation, that is, the excellence degree of each index is divided into five grades, V= (V1, V2, V3, V4, V5) = (excellent, good, medium, passing, failing). Table 1.

Table 1. Scoring Table

Grades	Excellent	Good	Medium	Passing	Failing
Scores C	100≤C≤90	90<C≤80	80<C≤70	70<C≤60	C<60

Determining the Membership Matrix

If the fuzzy vector $R_n = \left(r_{n1} \quad r_{n2} \quad \cdots \quad r_{nm}\right)$ is set, the fuzzy judgment relation matrix is:

$$R = \begin{pmatrix} R_1 \\ R_2 \\ \cdots \\ R_n \end{pmatrix} = \begin{pmatrix} r_{11} & r_{12} & .. & r_{1m} \\ r_{21} & r_{22} & .. & r_{2m} \\ .. & .. & .. & .. \\ r_{n1} & r_{n2} & .. & r_{nm} \end{pmatrix} \qquad （7）$$

Among them, R_n is the N-th evaluated index; r_{ij} is the membership R_n for each grade in the V, which means that starting from the i-th factor to give the possibility of the j-th evaluation; n is the number of indexes to be evaluated; m is the number of comment grade.

According to the requirements of model construction, 55 valid questionnaires collected from campus A can be adopted third-grade fuzzy evaluation. According to the grade with intensive evaluation, the respondents make judgments on different indexes of campus A to determine the membership of indexes, as shown in table 2:

Table 2. Campus emergency management capability evaluation index system, weights and campus a membership

The first grade index A	The second grade index B	The third grade index C	weight	grades				
				excellent	good	medium	passing	failing
Preventative capabilityIndex A1（0.3916）	Organizational structure B1（0.3756）	Institution setting C1	0.4367	0.40	0.40	0.10	0.07	0.03
		Job responsibilityC2	0.1386	0.33	0.37	0.17	0.07	0.07
		Emergency personnel's proportion and professional qualitiesC3	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 planC5	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
		Early-warning implementation C7	0.3112	0.13	0.23	0.40	0.23	0.00
	Educational training and exercise B3（0.2093）	Educational training and exercise 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 exercise implementation C10	0.3906	0.27	0.43	0.20	0.07	0.03
	Funds, materials	Emergency funds guarantee	0.2269	0.23	0.27	0.27	0.17	0.07

	and facilitiesB4（0.0987）	C11						
		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 organization 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 coordinationB7（0.1002）	Information collection, transmission and release C19	0.3619	0.33	0.27	0.23	0.13	0.03
		Material supply C20	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 control B8（0.3730）	Evacuation and rescue C23	0.5176	0.50	0.33	0.10	0.07	0.00
		Damage control measuresC24	0.3558	0.33	0.27	0.17	0.17	0.07
		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 constructionB10（0.3009）	Recovery construction plan 28	0.1671	0.23	0.27	0.23	0.17	0.10
		Facilities and system reconstruction C29	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 capabilityIndex A4（0.1632）	Case studyB11（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

A Fuzzy comprehensive evaluation on campus emergency management capability

According to the fuzzy comprehensive evaluation relationship: $B=W\circ R=(b_1\ \ b_2\ \ ..\ \ b_n)$, the fuzzy subset of the evaluation set is obtained: $B=(b_1\ \ b_2\ \ ..\ \ b_n)$, "$\circ$"is the blurring operator.

According to the weight vectors of the first grade index, the fuzzy evaluation result of campus A is:

$$B_{Acumpus} = W_1 \circ R_1 = \begin{pmatrix} 0.2945 & 0.3387 & 0.2116 & 0.1159 & 0.0406 \end{pmatrix}$$

According to the principle of maximum membership degree, it shows that the emergency management capability of A is good.

Safety Rating

In order to compare the difference of campus emergency management capability among different universities, the corresponding scores are given, and the scoring standards are quantified. The formula is Vk= (95,85,75,65,50):

$$W_P = \sum_{k=1}^{m} b_{pk} V_k \qquad （8）$$

Including p=Acampus；m=5；Vk=（excellent，good，medium，passing，failing）。

So, $W_{Acumpus} = 82.2005$. Campus A's emergency management capability is good.

CONCLUSION

This paper takes campus emergency management capability evaluation as the goal, construct the index system determines by adopting AHP and finally determines the index weights. It also use fuzzy comprehensive evaluation method to empirically analyze campus emergency management capability level, so as to find weaknesses existing in the campus emergency management capability, thus providing decision-making basis for strengthening the construction of campus emergency management capability.

REFERENCES

[1] Barton, L. (2001). *Crisis in organizations II*. Cincinnati: South-Western.

[2] Chen, W.（2014). Research and application of fuzzy synthetic evaluation method about the design quality of industrial products. *Advanced Materials Research, 9*, 637-642.

[3] Edwards, F. L., & Daniel, C. G. (2007). *Organizing for emergency management, emergency management: Principles and practice for local government*. Nigeria: ICMA Press.

[4] Eileen, W. K., & Stephanie, H. (2011). A model for assessment and mitigation of threats on the college campus. *Journal of Educational Administration, 49* (1), 76-94.

[5] Eugene, L. Z., & Norbert, W. D. (2007). *Campus crisis management: A comprehensive guide to planning, prevention, response and recovery*. San Francisco: Jossey-Bass.

[6] Guoqing, H., Mingxu, W., & Guoliang, W. (2012). Weight assignment research of improved entropy method in effectiveness evaluation. *Computer Engineering and Applications*, (8), 245-248.

[7] Henstra, D. (2010). Evaluating local government emergency management programs: What framework should public managers adopt? *Public Administration Review, 70*(2),

236-246.

[8] Ho, W., Xu, X.W., & Dey, D.K. (2010). Multi-criteria decision making approaches for supplier evaluation and selection: A literature review. *European Journal of Operational Research, 202*, 16–24.

[9] Hongyu, W., & Chaoyang, L.（2016). Efficiency evaluation of an internet plus university student affairs system based on fuzzy theory and the analytic hierarchy process. *Journal of Intelligent & Fuzzy Systems , 31*(3), 3121–3130.

[10] https://buzzorange.com/2015/10/02/10-killed-by-shooter-at-gun-free-oregon-community-college/.

[11] Jackson, B. A., & Sullivan, F. (2011). Are we prepared? Using reliability analysis to evaluate emergency response systems. *Journal of Contingencies and Crisis Management, 19*(3), 147-157.

[12] Koliba, C. J., Mills, R. M., & Zia. (2011). Accountability in governance networks: An assessment of public, private, and non-profit emergency management practices following hurricane Katrina. *Public Administration Review, 71*(2), 210-220.

[13] Moore, S., & Wallington, T. (2009). Diversity of current ecological thinking: Implications for environmental management. *Environ Manage, 43*(1), 17-27.

[14] Observer Net. (2015). *45 shootings happened in America this year*. Retrieved from

[15] Rebecca, B., & Herbert, S. (2013). *School shootings: International research, case studies, and concepts for prevention*. New York: Springer.

[16] Reddick, R., & Christopher, C. (2011). Information technology and emergency management: Preparedness and planning in the US states. *Disasters, 35*(1), 45–61.

[17] Sha, F., Zhongli, L., & Guang, S.（2015. Study on security risk assessment for information system based on fuzzy set and entropy theory. *Journal of Software Engineering, 9*, 818-827.

[18] Smith, D. C., & Sandhu, D. S. (2014). Toward a positive perspective on violence prevention in schools: Building connections. *Journal of Counseling and Development, 82*, 287-293.

[19] Wei, L., & Wanhong, Z. (2009). Strategic analysis on the reinforcing China's campus emergency management capability. *China Safety Science Journal, 19*(2), 132-133.

[20] Weike, Z., & Liying, Z. (2011). Study on campus emergency management capability evaluation. *Journal of Safety Science and Technology, 7*(11), 92-96.

[21] Xiaopeng, Z. (2011). *Research on the construction and capacity evaluation of public crisis management system*. China: Dalian University of Technology.

[22] Xinhuanet. (2008). *Global major disasters in nearly 40 years*. Retrieved from http://www.ce.cn/xwzx/gjss/gdxw/200805/14/t20080514_15454835.shtml.