



The Analysis on the Key Factors of Fire Rescue Course Content Design – A Case Study of Miaoli County

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ABSTRACT

This study discussed the factors affecting the design of the fire rescue and training courses for firefighters in Miaoli County. A questionnaire survey was conducted on firefighters. The content of the fire rescue courses held by Miaoli County Fire Bureau was discussed. Based on literature review and expert opinions upon Delphi method, this study analyzed the indicators of influencing factors. A hierarchical architecture was established. The weights affecting the design factor indicators affecting the fire rescue courses were obtained with the survey and analytic hierarchy process, and then were summarized and analyzed to establish a weight system.

Indexing terms/Keywords

fire rescue and training, analytic hierarchy process, Delphi method

INTRODUCTION

This study probed into the key factors affecting the design of the fire rescue training courses for firefighters in Miaoli County. In this study, the personal protection, life search and rescue, extinguishment operation, ventilated exhaust and other contents of the fire rescue training courses in Miaoli County were discussed.

According to Article 1 of the Fire Code, firefighters' three firefighting tasks consist of "fire prevention", "disaster rescue" and "emergent aid". Wherein, "disaster rescue" is more liable to cause the injury and death of firefighters. The items of rescue disaster can be further subdivided into fire, wind, water, earthquake, mudslide, air and marine perils, etc.; the occurrence rate of fire is the highest and it more tends to cause the injury and death of firefighters. Moreover, as the disasters in all urban areas have different characteristics, the training items to which all urban firefighting teams attach importance should be different. For instance, the expected disaster confronted by the firefighting squad in the science park may be poison chemistry or large-scale firing of factories, and thus the squad should focus on the training on poisoned disasters, large-scale life search and rescue, and fire extinguishment on the fireground. All urban firefighting teams should enhance the prevention and rescue of disasters frequently confronted by them based on the characteristics of urban areas, so as to effectively reduce the life and property losses of the public and the personal casualties of firefighters.

The author has been working in the firefighting field for ten years and has found that frequently, the trainings on fire rescue held by fire departments are mere formality, and the courses scheduled are frequently based on the content of the training of the elementary fire rescue classes of the training centers of fire departments. However,



the training provided by the classes aims at cultivating new firefighters, and thus its content and intensity don't meet the on-the-job firefighters' demand. Based on the above-said motives, this study has the following purposes:

- (1) Learn the outdoor firefighters' demand for disaster rescue, and boost relevant training courses so as to enhance the fire rescue knowledge and capabilities of firefighters.
- (2) For the characteristics of the disasters in the areas of Miaoli County, expect possible disasters, schedule the courses of relevant training, in order to shorten the response time of firefighters and reduce the life and property losses of the public.
- (3) Discuss on the disaster rescue habits of firefighters in Miaoli County, and formulate proper disaster rescue modular courses, so as to enhance the disaster rescue rapport among firefighting agencies.
- (4) Summarize and sort out the results of this study, and provide them to all training divisions of Miaoli County Fire Bureau and all fire prevention guards, so that they can be taken as reference when the fire rescue training course is held.

This study has the following limits:

- (1) Only firefighters in Miaoli County Fire Bureau are taken as the subjects of research, and the subjects of questionnaire are the outdoor firefighters and fire rescue training instructors in Miaoli County.
- (2) In this study, the content of the fire rescue courses involved in the all-year-round training planned by the Training Center of Miaoli County Fire Bureau was discussed.
- (3) As the characteristics of the disasters in local areas are different, the firefighting training funds and firefighting equipment scheduled and listed by local governments are different. So, this study's results are mainly based on Miaoli County Fire Bureau, and may be inapplicable to the firefighting departments of other local governments.

Research Process

The modified Delphi method and analytic hierarchy process (AHP) were adopted for this study. The research flow chart is set below:

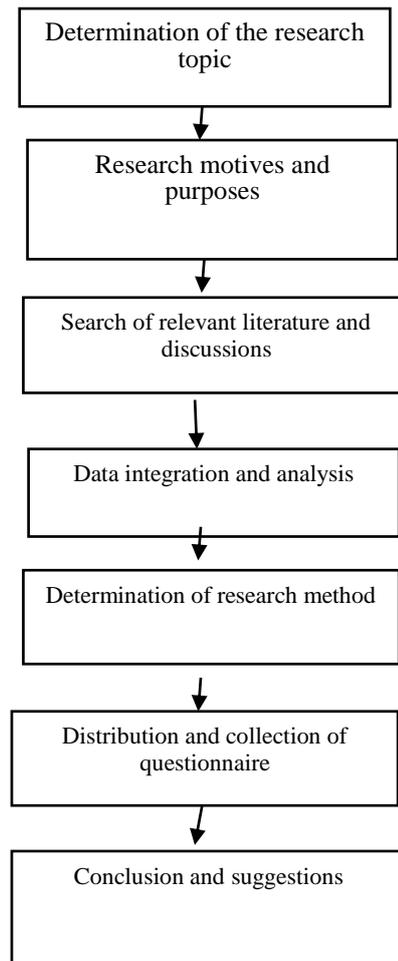


Figure 1 Research Process

RESEARCH METHOD

Based on the literature review, the key factors affecting the design of the fire rescue courses for firefighters in Miaoli County were preliminarily analyzed. The content applicable to the fire rescue courses of firefighters in Miaoli County were found. In addition, the key factors of the design of the fire rescue courses for firefighters in Miaoli County were found with the Delphi method and analytic hierarchy process (AHP). So, the literature could be divided into five parts: 1) Regulations on the implementation of the all-year-round training of firefighters; 2) the planning on the fire rescue courses of the training centers of the fires departments; 3) demand for all-year-round training; 4) theory and application of Delphi method; 5) theory and application of analytic hierarchy process.

Firefighters are the front-line guards over people's life and properties. To improve the firefighting and disaster rescue capabilities, proper training is necessary, and any successful education is based on the accurate assessment on the demands for education and training. For its firefighters, the National Fire Agency, Ministry of the Interior has formulated the "key operating points on the education and training courses held by National Fire Agency, MOI" and "regulations on the implementation of the all-year-round training of firefighters", and the annual training plan was formulated. However, there are different demands for the firefighting and



disaster rescue business, due to different conditions of geography and humanistic environments (Lin, 2009). Let's take Miaoli County as an example, the mountainous regions and hills around the county account for more than 80% of total, forest fire alarm frequently occurs, and shortage of water resources is also a great potential concern, since tap water pipelines cannot reach forests and fields. It has become one great issue for firefighters in Miaoli County how to effectively make use of water resources. At the same time, the content of the all-year-round training courses given by fire stations are frequently scheduled as per the regulations on the implementation of the all-year-round training of firefighters or the content of the elementary fire rescue class. However, as designated by (Lee, 2005), the design and planning of the training courses are too rigid, and there is no feedback mechanism for the assessment on training results. He suggested that the planning of regular courses should accord with the characteristics of all brigades, and the training courses should be planned and arranged in different ways based on the characteristics of the jurisdiction areas of all fire brigades, so as to practically trigger the willingness to learn.

In this study, the key factors of the design of the fire rescue courses for firefighters were discussed with the definition of modified Delphi method. The relative weights of various factors were analyzed with the analytic hierarchy process, and at the same time, the decision-making analysis on the training content of the fire rescue courses was carried out and the preference of on-the-job firefighters towards the content of fire rescue courses was investigated. According to the above-mentioned literature discussions and the mutual discussions among experts, the key factors affecting the design of the fire rescue and training courses were roughly divided into two aspects: Assessment on life search operation and fire extinguishing principle and operation. Relevant details are set below:

Life search operation: Through uniform literature sorting and the discussion by multiple instructors, seven courses, i.e., "wearing of personal protective equipment", "application of air respirators", "operational safety", "compulsory entrance", "life search", "handling method" and "application of two-section ladders" were listed as the aspects of life search assessment. Firefighters can more quickly bring the trapped people from a fireground and can save more live after mastering the seven fire rescue skills.

Fire extinguishing principle and operation: To more effectively control fire behaviors to reduce life and property losses, "application of water hoses and water guns", "application of water sources", "fire characteristics", "fire control", "ventilated exhaust" and "handling of residual fire" were listed in this regard. Firefighters can efficiently reduce the life and property losses of the public by getting familiar with these fighting skills: learning the characteristics of fire, making full use of water sources, making the water sources uninterrupted, rapidly completing routing and indoor rescue, and after fire behavior control, carefully completely extinguishing the residual fire and sorting the fireground by enhancing the visibility through ventilated exhaust.

This study covers the analysis on relevant literature and data, the integrated opinions of fire rescue instructors in Miaoli County, and practical experience of outdoor firefighters. Moreover, the relative weights of the key factor assessment indicators for the design of the fire rescue courses of firefighters in Miaoli County were obtained through sorting and analyses, while the modified Delphi method and analytic hierarchy process were taken as the main theoretical study tools. The study process is described in details as follows:



Definition of the decision-making item:

Based on the study background and motives, the research topic was decided (key factors of the design of the fire rescue courses for firefighters). This study aims at discussing the factors affecting the design of the fire rescue courses for firefighters and the relative weights among all the factors. Besides, the relation between the course design and the outdoor firefighters was analyzed.

Discussion on relevant literature:

The literature and data related to firefighting rescue and course design were collected, discussion and analysis were carried with along with the fire rescue instructors in Miaoli County, the study methods of the modified Delphi method and analytic hierarchy process were studied, and afterwards, the key factors of the design of the fire rescue courses for firefighters were studied and proposed.

Decision-making framework:

The decision-making framework was determined from two perspectives:

Discussion on decision-making factors: A questionnaire survey was carried out towards fire rescue instructors, and then the questionnaires were recovered and summarized. Later on, the results were integrated and analyzed with the “modified Delphi method”, so as to establish the hierarchical decision-making framework.

Discussion on the decision-making scheme: Relevant literature and data were discussed to formulate the content and items of fire rescue courses. Then, the hierarchical decision-making framework was established by taking them as the decision-making factors.

Validation study:

The relative weights among all decision-making factors were compared with AHP, so that outdoor firefighters can compare the importance of every two factors. The study steps are set below:

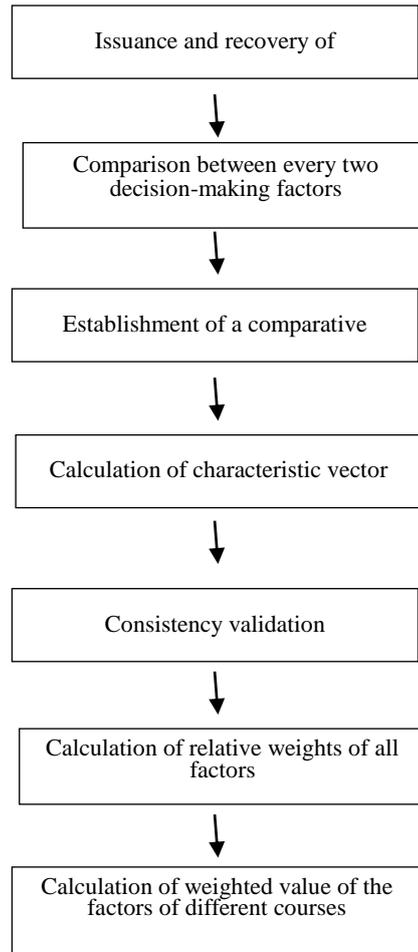


Figure 2 Research procedures

Analysis and discussion on the validation result:

The key factors of the design of the fire rescue courses for firefighters were discussed, after the weighted proportions of all factors were analyzed based on the above-said resulting data and arranged.

Conclusion and Suggestions:

Based on the above analytical results, the reference for the formulation of fire rescue training courses was provided to the Training Department of Miaoli County Fire Bureau, and the reference direction for the all-year-round fire rescue training courses to be held by all fire prevention guards of Miaoli County Fire Bureau, for the purpose of improving the training quality. In this way, firefighters can fully apply what they have learned to actual fire rescue, and reduce the life and property losses of the public as well as the risks in their operations.

RESULTS AND ANALYSIS

In the first stage of this study, the expert questionnaire was analyzed with the Delphi method, and the respondents were eleven fire rescue officers of Miaoli County Fire Bureau (who had received the qualification

certificates on fire rescue of the Training Center of National Fire Agency, Ministry of the Interior); in the second stage, discussion was carried out with the analytic hierarchy process, and the respondents were fifty on-the-job firefighting personnel of Miaoli County Fire Bureau.

The key factor indicators of the design of the fire rescue courses for firefighters were defined with the expert questionnaire of modified Delphi method, and the hierarchical decision-making framework diagram was established. The questionnaire results were analyzed as follows:

Goal layer	Sub goal layer	Statistical result (average /percentage)	Standard deviation	Decision-making item	Statistical result (average /percentage)	Standard deviation	Acceptable or not
Key factors of the design of the fire rescue courses for firefighters in Miaoli County	Life search operation	4.73/94.6%	0.5	Wearing of personal protective equipment	4.18/83.6	0.60	Yes
				Application of air respirators	4.09/81.8	0.70	Yes
				Operational safety	4.73/94.6	0.47	Yes
				Compulsory entrance	4.27/85.4	0.47	Yes
				Life search	4.36/87.2	0.50	Yes
				Application of two-section ladders	4.36/87.2	0.50	Yes
	Fire extinguishing principle and operation	4.55/91.0%	0.67	Application of water hoses and guns	4.18/83.3	0.40	Yes
				Application of water sources	4.18/83.6	0.40	Yes
				Characteristics of fire	4.09/81.8	0.30	Yes
				Fire control	4.91/98.2	0.30	Yes

				Ventilated exhaust	4.55/91.0	0.52	Yes
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Table 1

The results were analyzed and concluded through 2 expert questionnaires of modified Delphi method. Thus, the factors affecting the design of fire rescue training courses for firefighters in Miaoli County were defined, the analytical hierarchy process questionnaire was designed with the hierarchical decision-making framework diagram and then sent to the outdoor firefighters of Miaoli County. The hierarchical framework diagram is set below:

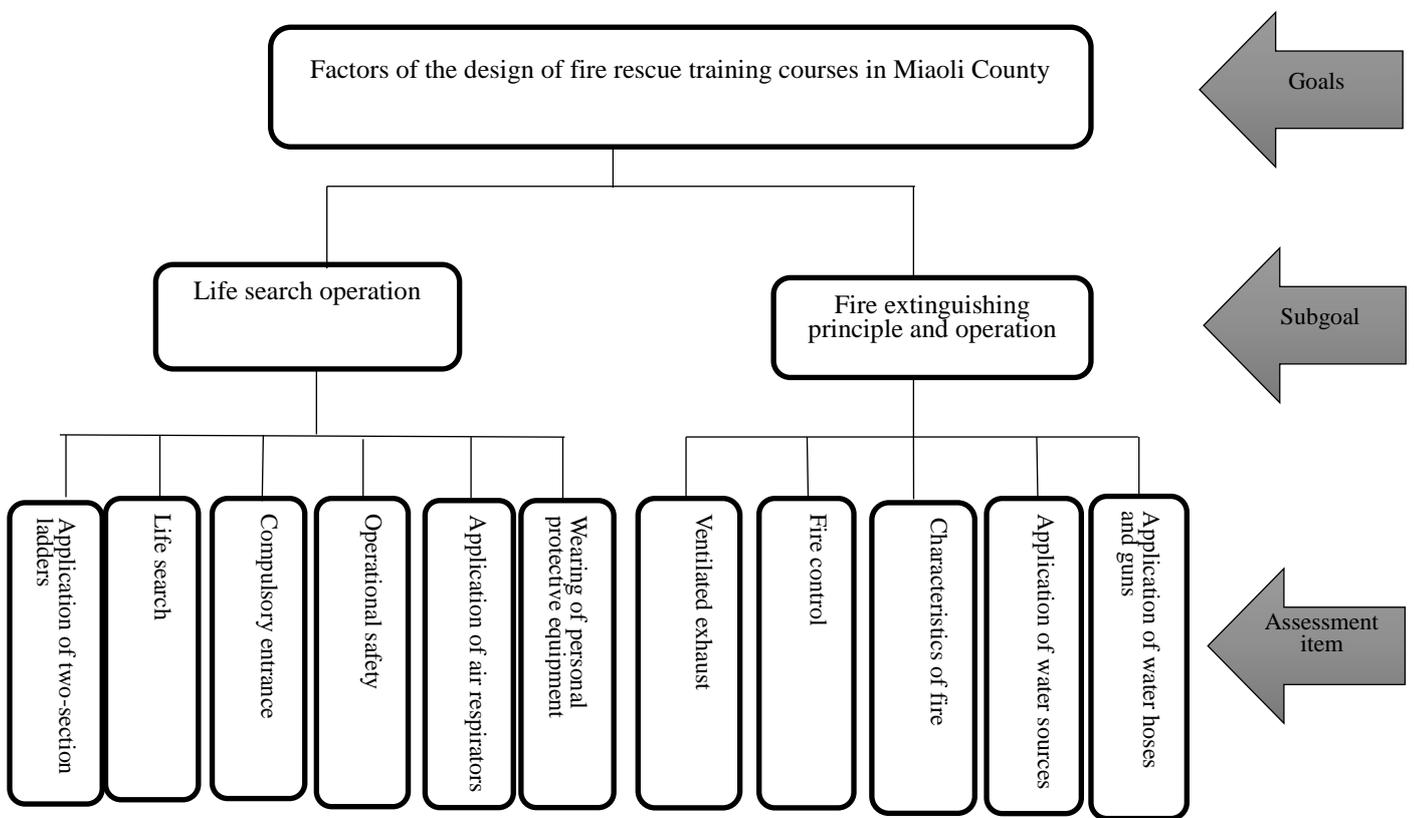


Figure 3

Based on the above-said hierarchical framework, an analytical AHP hierarchical questionnaire was designed for the outdoor firefighters of Miaoli County, the relative weights among all factors were calculated through the comparison between every two factors, and at the same time, the opinions and expectation of outdoor firefighters for the content of fire rescue courses were analyzed, so as to achieve the study purpose. The questionnaire results are set below:

Weight sequencing	Degree of emphasis (percentage)	Decision-making item	General weight distribution	Aspect
1	High (70%)	Operational safety	0.196	Life search operation
2		Wearing of personal protective equipment	0.150	Life search operation
3		Application of air respirators	0.136	Life search operation
4		Life search	0.114	Life search operation
5		Application of water sources	0.091	Fire extinguishing principle and operation
6	Moderate (30%)	Application of water hoses and guns	0.073	Fire extinguishing principle and operation
7		Compulsory entrance	0.062	Life search operation
8		Characteristics of fire	0.061	Fire extinguishing principle and operation
9		Fire control	0.046	Fire extinguishing principle and operation
10		Application of two-section ladders	0.045	Life search operation
11		Ventilated exhaust	0.021	Fire extinguishing principle and operation

Table 2

Conclusion:

Based on the final result analysis of the study, there are eleven decision-making reference items for the factors affecting the design of fire rescue courses of Miaoli county Fire Bureau, and they are sequenced based on the weights as “operational safety”, “wearing of personal protective equipment”, “application of air



respirators”, “life search”, “application of water sources”, “application of water hoses and guns”, “compulsory entrance”, “characteristics of fire”, “fire control”, “application of two-section ladders”, “ventilated exhaust”, of which the first five items are highly thought of by the outdoor firefighters in Miaoli County, accounting for 70%; the last five items are moderately thought of by the same, accounting for 30%.

According to the analysis on the hierarchical analytical AHP questionnaire of the study, it can be known that the hierarchy of the factors affecting the design of fire rescue courses in Miaoli County has been sequenced as life search operation as well as fire extinguishing principle and operation. The influencing factor indicators which outdoor firefighters think highly of are “operational safety”, “wearing of personal protective equipment”, “application of air respirators”, “life search” and “application of water sources” in sequence. Since the rescue sequence for firefighters is themselves and their team mates, followed by the trapped, they must firstly well protect themselves before saving the trapped. First priority is given to the self-safety all the time. They should search the trapped indoors after learning the operational safety, wearing the personal protective equipment, correcting using the air respirator and ensuring their self-safety. Moreover, the firefighting vehicles in the periphery should ensure that the water sources are uninterrupted, so that sufficient water can be provided for the firefighters entering the rooms for rescue and fire extinguishment.

This study only aims at the training of outdoor firefighters of Miaoli County Fire Bureau, and the optimal scheme sequence selected by them cannot be directly apply to other areas.

Suggestions:

Based on the analysis on the study results, the fire rescue courses should be designed and organized based on personal operation safety as far as possible, with the life search techniques, application of water sources and other courses interspersed. In this way, the familiarity of firefighters with personal protective equipment can be enhanced by training, in order to ensure their safety on the fireground.

The study suggestions are set below:

In recent years, fire departments would make a firefighter casualty into case education if any, and send the document to all fire stations. It is suggested to share the case education with outdoor firefighters in all-year-round training, conduct discussion for preventing that any firefighters get injured by repeating the mistake.

It is suggested to formulate a uniform fighting module to simplify modules, so that all squads can master rescue techniques uniformly and simulate the disaster through drilling, enhancing the rescue rapport among all of them.

It is suggested to buy fire rescue appliances, like thermal imaging machines, search lamp cords, etc., and handle the education and training on these appliances, so that firefighters can master the states of the buildings, their search progress can be accelerated, the survival rate of the trapped can be increased, and the life and property losses of the public can be reduced.



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