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Analysis and Needs Assessment of Chemical Response and Hazardous Substances of Bangkok Fire Fighters

Jessadanan Wiangnon[1], Nuchcha Phonphoton[2*], Pathanin Sangaroon[3] and Phommin Kongmon[4]

[1]Institute of Metropolitan Development, Navamindradhiraj University, Bangkok 10300, Thailand
[2*]Faculty of Sciences and Health Technology, Navamindradhiraj University, Bangkok 10300, Thailand
[3]School of Health Science Sukhothai Thammathirat Open University (STOU), Nonthaburi 11120, Thailand
[4]Bangkok Fire and Rescue Department, Bangkok 10400, Thailand
[*]E-mail : nuchcha@nmu.ac.th

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Abstract

This study aimed to analyze and assess of chemical response and hazardous substances of Bangkok Firefighters (Fire and Rescue Department) and use the Analytic Hierarchy Process (AHP) to prioritize management issues. The study is a mixed method with 400 officers for the sample group and using the identification of informants through purposive sampling and willingness to provide information after collecting the data, the statistics used for testing were: descriptive statistics, percentage statistics, mean, and adjusted PNI index values. The sample group had a bachelor's degree (46.75%), had experience working as a fire officer in Bangkok for more than 9 years (54.50%), and had training experience in chemicals and hazardous substances in 1-3 training courses (53.25%). The results of AHP analysis found 5 management issues. For management to be used effectively, it can be grouped holistically and arranged in descending order. The stakeholders give the most importance to reviewing the plan to extract lessons and find limitations or obstacles in carrying out activities to propose policies for the next time (0.44), the measures to prevent dangers from emergencies, chemicals, and hazardous substances (0.26), the creating a plan to prevent and respond to emergencies from chemicals and hazardous substances at fire and rescue stations (0.14), the preparing emergency response teams from chemicals and hazardous substances at fire and rescue stations (0.10), and the preparing equipment for emergency response from chemicals and hazardous substances at fire and rescue stations (0.06), respectively. The application of the analysis results in managing problems that require the most attention is reviewing plans to draw lessons and find limitations or obstacles in carrying out activities to propose policies for improvement, change, and development of operating models to be consistent with most current situations. Moreover, it is a guideline for developing measures to prevent emergency chemical hazards and hazardous substances while working that will help reduce the loss of property and life.

Keywords : Firefighters; Need assessment; Chemicals and hazardous substances

Introduction

The current disaster situation in Thailand and Bangkok has many disasters occurring and becoming more severe due to various factors and changing trends as a result of global warming and climate change. There were also social changes in various aspects, such as change from rural society to urban society, the increase in workers from neighboring countries when the ASEAN community opened. Changes from various climatic and social factors affect using science and technology in various developments including chemicals and hazardous substances that are used in various activities in the agricultural sector, industrial sector, and many

other activities [1]. The results of using various chemicals and hazardous substances without knowledge and understanding as well as a lack of caution regarding safety in production, storage, packaging, and transportation. Regulatory developments often arise from significant process safety incidents. The scope of regulation and the quality of enforcement vary from country to country, generally influenced by regulations from developed countries [2], but at present the regulations have not been enforced to the same level, which may cause accidents and damage to life and property. It can also affect health and the environment. Therefore, it is necessary to have preventive measures and be prepared to solve the problem of chemical and hazardous substance accidents in the event of an emergency, this often causes the rapid spread of toxins but can be measured using modern technology [3] such as detection technology modern communication technology and database. This allows us to use simulation experiments to analyze serious accidents caused by hazardous chemicals. Due to the toxicity and spread of hazardous chemicals, these accidents often result in not only serious economic losses but also traffic congestion at the same time [4]. This includes the risk-based response characteristics and response to security events of the event. Progress assessment Information about the properties of hazardous chemicals protective measures Various precautions are taken at all levels of government and private sector operations [5]. Risk analysis is very important for preventing and mitigating potential accidents. Practical risk assessments can use models and data from networks that can identify other risk factors that may occur and result in operational failure. In emergencies, we can reduce the accident rate during work by using the Fuzzy Logic method, which can reveal defects in some work equipment even if strict measures are followed [6]. Bangkok's population has greatly increased in the past. There is continuous expansion of urban areas. It is the center of progress in every aspect. There is a high density of buildings and various types of housing [7]. If security management is not efficient enough when a public disaster occurs and cannot be solved in time for the situation. Often causing damage and loss at a severe level. It affects the economy both in the short term and in the long term [8], and may cause great damage to society, especially the psychological which is difficult to heal in a short period. Lack of confidence in the safety of people's lives may affect their long-term health [9]. Chemical hazards are specific hazards. It requires the use of specialized expertise of officials from various agencies. In the Bangkok area, these include the Health Department, the Department of Disaster Prevention and Mitigation, the Pollution Control Department, and the Department of Disaster Prevention and Mitigation. In response to chemicals and hazardous substances, it is necessary to take preparedness measures for officials from the agency able to support chemical and hazardous material accident operations on time by preparing emergency action plans with clear guidelines strengthening the capacity of command personnel according to the command system at the scene of the incident and emergency operators in chemical disaster suppression techniques. Including preparing appropriate tools and equipment to effectively manage chemical hazard emergencies and safe for officials people in the area and reduce the impact on the quality of the surrounding environment [10].

This study has the objective to analyze of chemicals response and hazardous substances of Bangkok Firefighters (Fire and Rescue Department) in the actual conditions in to assess and prioritize emergency response needs to chemicals and hazardous substances of Firefighters. The results of the study will be an important database for considering and applying information to develop clear emergency action plans that can be used effectively.

Material and Methods

This study is a mixed methods and all details of the study procedures were qualitative part and Quantitative part are shown in Fig. 1 and below.

1. Qualitative research, collect information from various documents that are theories and concepts, related research documents, and government documents regarding policy implementation for analysis the needs in response to chemicals and hazardous substances of Bangkok fire officials.

Collect data using an interview form as a tool for collecting data and analyze management issues holistically using the Analytic Hierarchy Process (AHP).

2. Quantitative research, conduct a study on the Office of Disaster Prevention and Mitigation Bangkok (Bangkok Fire and Rescue Department) to collect data. The population used in this research is Firefighters of the Bureau of Disaster Prevention and Mitigation Bangkok Data were collected from a sample group of 10 fire stations per fire station, 40 stations, totaling 400 people, using the identification of informants. The purposive sampling and willingness to provide information after collecting the data was analyzed with the SPSS statistical experiment program. The statistics used for testing were: descriptive statistics, percentage statistics, mean, adjusted PNI index values.

Results and Discussion

The results found that the characteristics of a sample group of 400 firefighters in Bangkok had different basic characteristics. The majority of the sample was male 97.75%, had a bachelor's degree (46.75%), and had experience working as a fire officer in Bangkok for more than 9 years 54.50% (Table 1). Moreover, most of the sample group had 1-3 training courses on chemicals and hazardous substances 53.25% and belonged to the Fire and Rescue Operations Division Fire and Rescue Operations Division 1 for 27.25% (Table 2).

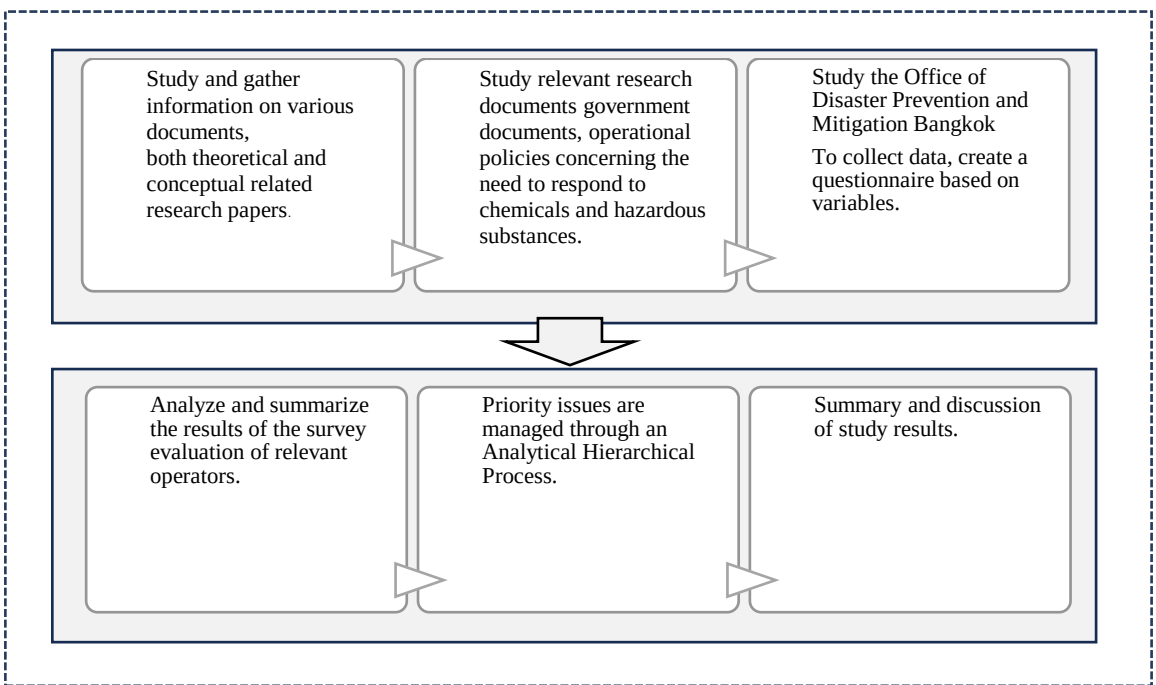

Figure 1 Work processes

Table 1 General information of the sample

Questions	Male		Female		Sum	
	Total (person)	p.c. (%)	Total (person)	p.c. (%)	Total (person)	p.c. (%)
Age						
less than 25 years	7	1.75	1	0.25	8	2.00
25 – 35 years	86	21.50	5	1.25	91	22.75
36 – 45 years	215	53.75	3	0.75	218	54.50
more than 45 years	83	20.75	0	0	83	20.75
Total	391	97.75	9	2.25	400	100
Highest educational qualification						
Professional certificate	40	10.00	2	0.50	42	10.50
Higher vocational certificate	111	27.75	2	0.50	113	28.25
Bachelor's degree	187	46.75	4	1.00	191	47.75
Master's degree	49	12.25	1	0.25	50	12.50
other	4	1.00	0	0	4	1.00
Total	391	97.75	9	2.25	400	100
Work experience current position						
less than 1 year	10	2.50	1	0.25	11	2.75
1-3 year	58	14.50	4	1.00	62	15.50
4-6 year	58	14.50	3	0.75	61	15.25
7-9 year	47	11.75	0	0	47	11.75
more than 9 years	218	54.50	1	0.25	219	54.75
Total	391	97.75	9	2.25	400	100

Table 2 Training experience in chemicals and hazardous substances

Questions	Male		Female		Sum	
	Total (person)	p.c. (%)	Total (person)	p.c. (%)	Total (person)	p.c. (%)
Training experience						
No training experience	148	37.00	8	2.00	156	39.00
Have experience in 1-3 training courses	212	53.00	1	0.25	213	53.25
Experienced in more than 3 training courses	31	7.75	0	0	31	7.75
Total	391	97.75	9	2.25	400	100
Under the Fire and Rescue Operations Division						
Fire and Rescue Operations Division 1	108	27.00	1	0.25	109	27.25
Fire and Rescue Operations Division 2	82	20.50	5	1.25	87	21.75
Fire and Rescue Operations Division 3	48	12.00	0	0	48	12.00
Fire and Rescue Operations Division 4	29	7.25	0	0	29	7.25
Fire and Rescue Operations Division 5	101	25.25	2	0.50	103	25.75
Fire and Rescue Operations Division 6	23	5.75	1	0.25	24	6.00
Total	391	97.75	9	2.25	400	100

The results of this research are consistent with the chemical accident management cycle of the Pollution Control Department which has established a cycle of practice, there were protective measures, a planning aspect, a preparation aspect, and an emergency response. Content analysis results were obtained from additional suggestions in the questionnaire and inductive analysis (analytic analysis) to create a summary of management issues. There were additional suggestions from experts in the process of analyzing the consistency values of the tools (Item Objective Congruence Index: IOC) by the analysis results IOC = 0.96 IOC (acceptance values range from 0.8 –1) found that this is the issue of reviewing the plan to extract lessons and find limitations or obstacles in carrying out activities. Suggestions from stakeholders who are separate from the research issues can be analyzed to prioritize overall management issues, which will make the conclusions more complete. Results of analysis of management issues with analytical hierarchical process using a total of 16 people involved as stakeholders and related parties in 5 groups, there were 3 academics from universities with courses in safety management, 3 academics from universities with courses in safety and health management, 5 executives of agencies or organizations that provide programs training, 5

interested in training and 3 executives of the agency or organization responsible for organizing the training (Table 3). The results of AHP analysis found that there were a total of 5 management issues. In order for management to be used effectively, it can be grouped holistically. Arranged in descending order : 1) Reviewing the plan to extract lessons and find limitations or obstacles in carrying out activities in order to propose policies for the next time. 2) Measures to prevent dangers from emergencies, chemicals and hazardous substances while working. 3) Creating a plan to prevent and respond to emergencies from chemicals and hazardous substances at fire and rescue stations. 4) Preparing emergency response teams from chemicals and hazardous substances at fire and rescue stations and 5) preparing equipment for emergency response from chemicals and hazardous substances at fire and rescue stations, respectively as shown in Table 4.

Applying the results of the analysis of the overall sequence of management issues in the analytical hierarchy process. It shows the issues that need the most attention, including reviewing the plan to extract lessons and finding limitations or obstacles in carrying out activities to propose policies for the next time. It is an important part of improving, changing, and developing the style and methods of operation to be most consistent with the present. Discovering operational limitations Including other factors beyond our control that will affect the overall picture of operations in various emergencies. Second are measures to prevent danger from emergency chemicals and hazardous substances while working. Because having good measures will reduce the loss of property and life. This will be related to restructuring the workforce for efficient workers or reducing the loss of important personnel. It is also an indication of the efficiency and stability of the organization. Other than that, the other points are of similar importance as the details are practically consistent. which can be developed together. Presenting the results of the analysis of management issues can also be used to develop an efficient working system. Having a model and receiving information from stakeholders is essential to operating in almost any emergency situation. Lessons learned can lead to the creation of appropriate policies and will create a learning process for efficient and sustainable development of both the agency and the network in the future.

Table 3 Conditions that should be actual condition and necessary needs in response to chemical emergencies and hazardous substances

List	Should be (I)		Actually (D)		$PNI_{modified}$	Order importance	Order essential requirements
	$\bar{X}$	SD	$\bar{X}$	SD			
1. Measures to prevent emergency hazards from chemicals and hazardous materials while working.							
1.1 Fireman receive training in controlling, managing, or responding to emergencies from chemicals and hazardous substances.	3.87	1.14	2.22	1.06	3.30	3	high
1.2 Risk levels from chemicals and hazardous substances are assessed of establishments in the area of responsibility.	3.84	1.14	2.40	0.93	3.22	4	high
1.3 There is a survey and collection of data on the type and quantity of chemicals stored or used of establishments in the area of responsibility.	3.94	1.14	2.49	1.14	3.30	3	high
1.4 Workers can use safety documents such as chemical labels, MSDS manuals. To correctly respond to chemical and hazardous material accidents.	3.98	1.16	2.34	1.17	3.39	2	high
1.5 Workers wear personal protective equipment and equipment. while working correctly every time.	4.09	1.09	2.76	1.25	3.41	1	high
Total average	3.94	1.13	2.44	1.11	3.32	-	high
2. Preparation of equipment for responding to emergencies from chemicals and hazardous substances of fire and rescue stations.							
2.1 Have chemical protection suit level A or B or C.	4.07	1.12	2.38	1.22	3.48	2	high
2.2 Have personal protective equipment (PPE) such as masks, gloves, and shoes.	4.03	1.09	2.86	1.21	3.32	7	high
2.3 There are materials and tools to respond to accidents caused by chemical spills and hazardous materials spills, such as gas measuring tools. Chemical absorbent materials, sand, shovels, chemical containers, etc.	4.12	1.10	2.89	1.30	3.42	3	high
2.4 There are safety area control equipment such as distance barrier tape, rubber cones, danger warning signs, etc.	4.02	1.10	2.56	1.23	3.39	5	high
2.5 Have a personal communication device.	4.09	1.12	2.93	1.36	3.37	6	high

List	Should be (I)		Actually (D)		$PNI_{modified}$	Order importance	Order essential requirements
	$\bar{X}$	SD	$\bar{X}$	SD			
2.6 There is first aid equipment.	4.10	1.17	2.17	1.17	3.57	1	high
2.7 There is a sound amplifying device. To be used to provide warnings to officials and people in the vicinity.	3.93	1.16	2.45	1.18	3.57	1	high
2.8 There are substance measuring tools such as air detectors. Temperature measuring device, etc.	3.98	1.17	2.30	1.07	3.40	4	high
Total average	4.04	1.13	2.57	1.22	3.41	-	high
3. Preparing emergency response teams for chemicals and hazardous substances of fire and rescue stations.							
3.1 The fire station's emergency operations unit has been prepared.	3.91	1.16	2.27	1.06	3.32	3	high
3.2 Plans are rehearsed, plans are reviewed, and plans are revised for use in suppressing emergencies from chemicals and hazardous substances.	3.92	1.15	2.25	1.07	3.32	3	high
3.3 Define roles and responsibilities in responding to chemical and hazardous substance emergencies according to the specified plan.	3.95	1.14	2.22	1.01	3.38	2	high
3.4 Equipment is inspected and maintained. Used in responding to chemical and hazardous substance accidents.	3.97	1.16	2.37	1.08	3.32	3	high
3.5 There is coordination for joint operations between relevant departments both internally and externally.	4.02	1.14	2.41	1.11	3.42	1	high
Total average	3.95	1.15	2.30	1.06	3.37	-	high
4. Preparation of emergency prevention and response plans from chemicals and hazardous materials of fire and rescue stations.							
4.1 There is coordination of control. and manage the area to evacuate and help the injured.	4.01	1.17	2.39	1.11	3.41	2	high
4.2 There is an action plan to respond to chemical and hazardous substance accidents.	3.99	1.19	2.36	1.16	3.40	3	high
4.3 There is an action plan for cleaning up chemical contamination for workers and disaster victims.	4.02	1.16	2.33	1.10	3.44	1	high
4.4 There is coordination to jointly operate between the relevant internal and external agencies.	4.04	1.14	3.18	1.29	3.25	5	high
Total average	4.02	1.15	2.68	1.19	3.36	-	high

Note : "I" = the condition that should be in response to a chemical emergency and hazardous substances.
"D"= the actual condition for responding to a chemical emergency and hazardous substances.

Table 4 Analysis of management issues with Analytic Hierarchy Process (AHP)

	MANAGEMENT ISSUES SCORE				
STAKEHOLDERS	**Reviewing the plan to extract lessons and find limitations or obstacles in carrying out activities in order to propose policies for the next time.**	**Measures to prevent dangers from emergencies, chemicals and hazardous substances while working.**	**Creating a plan to prevent and respond to emergencies from chemicals and hazardous substances at fire and rescue stations.**	**Preparing emergency response teams from chemicals and hazardous substances at fire and rescue stations.**	**Preparing equipment for emergency response from chemicals and hazardous substances at fire and rescue stations.**
1	0.45	0.26	0.14	0.09	0.06
2	0.53	0.30	0.06	0.05	0.06
3	0.46	0.26	0.11	0.11	0.06
4	0.56	0.14	0.15	0.08	0.07
5	0.39	0.22	0.20	0.12	0.07
6	0.30	0.22	0.17	0.23	0.08
7	0.32	0.35	0.13	0.14	0.06
8	0.36	0.37	0.13	0.09	0.05
9	0.23	0.30	0.16	0.17	0.14
10	0.49	0.27	0.13	0.06	0.05
11	0.45	0.26	0.12	0.09	0.08
12	0.55	0.20	0.12	0.08	0.05
13	0.50	0.25	0.16	0.05	0.04
14	0.56	0.24	0.10	0.06	0.04
15	0.31	0.15	0.21	0.17	0.16
16	0.57	0.25	0.08	0.06	0.04
average	0.44	0.26	0.14	0.10	0.06
				(C.I.)	**0.10**
				(C.R. <0.1)	**0.09**

Conclusions

This research is an assessment of the chemical response and hazardous substances of Bangkok Firefighters. The objective is to study the conditions that should be and the actual conditions in responding to chemical and hazardous substance emergencies and assess and prioritize the needs of Bangkok firefighters in responding to chemical and hazardous material emergencies. The sample group was male (97.75%), had a bachelor's degree (46.75%), and had experience working as a fire officer in Bangkok for more than 9 years (54.50%). More than half had training experience in chemicals and hazardous substances in 1-3 training courses (53.25%) and belonged to Fire and Rescue Operations Division 1 (27.25%). The results from AHP found the stakeholder's group gave the most importance to the issue of reviewing the plan to extract lessons and find limitations or obstacles in carrying out activities to propose policies for the next time, which is consistent with real conditions in measures to prevent danger from emergency chemicals and hazardous substances. Therefore, it is important to review plans and provide information to present policies that should be given priority to have measures to prevent emergency chemical hazards and hazardous substances in work that are appropriate for actual conditions in the future.

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