# A STUDY ON FIRE SAFETY & AWARENESS AMONG THE OCCUPANTS IN UNIVERSITI TUNKU ABDUL RAHMAN (UTAR), KAMPAR CAMPUS

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A project report submitted in partial fulfilment of the requirements for the award of Bachelor of Science (Honours) Environmental, Occupational Safety and Health

> Faculty of Engineering and Green Technology Universiti Tunku Abdul Rahman

> > September 2022

# DECLARATION

I hereby declare that this project is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has been previously and concurrently submitted for any other degree or awarded at UTAR or other institutions.

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# A STUDY ON FIRE SAFETY & AWARENESS AMONG THE OCCUPANTS IN UNIVERSITI TUNKU ABDUL RAHMAN (UTAR), KAMPAR CAMPUS

#### ABSTRACT

Fire incident is one of the most disastrous events which can results in severe casualties, environmental impacts, and property loss. In fact, level of fire awareness among the Malaysians are relatively low. The first aim of this study is to evaluate the level of the fire safety and awareness among the occupants in Universiti Tunku Abdul Rahman (UTAR), Kampar Campus. The following aim of study is to determine the relationship between the level of fire awareness with another three variables, which are fire knowledges, human factors in fire safety, and the fire hazards with its consequences by using Pearson Correlation Coefficient. This study was conducted by distributing the prescribed questionnaires to the staffs and students in UTAR, Kampar Campus. There were 389 respondents who had participated in the survey. The data obtained from this study will be analyzed by using SPSS26. The results of Cronbach's alpha for level of fire awareness, fire knowledge, fire hazards with its consequences, and human factors in fire safety are 0.804, 0.828, 0.835, and 0.665. Based on the results of Pearson correlation, the level of fire awareness is strongly correlated with fire knowledges and fire hazards with its consequences, whereas there is no correlation between human factors with the level of fire awareness. Therefore, the management of UTAR should put more focus on improving the fire knowledge and managing the fire hazard in the campus.

(230 words)

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# LIST OF ABBREVIATIONS

NFPA National Fire Protection Association
SIRIM Standard and Industrial Research Institute of Malaysia
UBBL 1984 Uniform Building By-Law 1984
US EPA United States Environmental Protection Agency

# **CHAPTER 1**

# INTRODUCTION

#### 1.1 Overview

#### **1.1.1 Fire Accidents**

Fire can happen at anywhere and anytime. In daily life, peoples can simply spot the news articles reporting fire occurrences in different parts of the world. Throughout the years, the commercial and non-commercial buildings are subjected to natural disasters such as tsunami and earthquake, as well as anthropogenic hazard like fire (Kodur, Kumar and Muhammad Masood Rafi, 2019). The term commercial properties mean any structural buildings used as office, restaurant, industrial operations, educational, entertainment, retailing, and other properties for public use which can make profits (Hard Fire Suppression System Inc., 2021). In Malaysia, non-commercial or residential properties are terrace house, semi-D, bungalow, apartments, condominium and etc. These properties mostly used as housing area or non-commercial purpose (Insight Estates, 2015). However, the classification might vary with other countries.

Not only the structure fires, wildfires also occurred almost every year. According to Environmental Protection Agency (EPA), the National Interagency Fire Center had compiled statistical data of wildfires occurrences for each year. There are around 70,000 wildfires have been reported in nationwide (US EPA, 2020). In retrospect, numerous deadly wildfires are recorded in human history. For instance, the deadliest wildfires is Peshtigo fire that was recorded in 8<sup>th</sup> October 1871. The fire had totally affected the whole Great Lake region and spread through Wisconsin, Michigan and Illinois, United States (All Top Everything, 2020). The event had claimed more than 1,500 lives which equivalent to 85 percent of the town population.

On 12<sup>th</sup> January 2022, large-scale commercial fire happened in Adelanto, California. Two commercial buildings had totally destroyed in the fire and it has high potential to affect the residential area nearby the building if the fire was not contained effectively (Yee, 2022). As reported by Reimer, the fire had engulfed 2500 blocks of McGillivray Boulevard and it took about 2 days to extinguish the fire (Reimer, 2021). Not only that, the fire occurrence was reported in Hamer, Idaho, December 2021, the three commercial buildings were completely destroyed in the fire and involved one injury (Newsflow, 2021).

The extensive fire broke out was reported in the Grenfell Tower which located in London as shown in **Figure 1.1**. There were 9 people being killed in the fire and more than 74 people suffered from injuries (Winsor and Stevenson, 2017). Liberation reported the six storey apartment complex in New York caught fire on 5 February 2022. The incident involved 10 injuries including a firefighter (Souers, 2022).



Figure 9.1 Grenfell Tower Fire (Winsor and Stevenson, 2017)

## **1.1.2 Causes of Fire Occurrence**

To conclude the causes of fire occurrences mentioned in previous parts, the fire occurrences happened mostly due to faulty appliances such as heater, improper selection of material used as the component of building, incompliance to government standard, improper handling and storage of chemicals, malfunction of fire detection systems, self-closing door and landlord negligence.

The faulty appliances are known as the significant cause of fire occurrence. The faulty appliances have high potential to produce spark and even cause explosion which can result in extensive damage and casualties. For example, the fire incident happened at Grenfell Tower in London is due to the faulty fridge freezer as shown in **Figure 1.2** (Diebelius, 2018). The faulty space heater also leads to fire occurrence at the six storey apartment complex of 2397 Grand Avenue in Bronx, New York (Chang, 2022).



Figure 1.10 Starting point of fire: Faulty electrical appliances (Diebelius, 2018)

In addition, landlord negligence indicates failure of the fire management system of the particular building. This means that more people are exposed to fire hazards which has high potential to results in casualties or other catastrophic damages. For instance, the 2397 Grand Avenue apartment complex fire in New York City. The landlord refused and fail to bear the responsibilities in providing safe and healthy environment for the residents (Souers, 2022). Therefore, the landlord used to push the responsibilities to the tenants themselves and blame the tenants for not closing the door which eventually caused the fire to spread (Souers, 2022). The irresponsible landlord chose to ignore the concerns and complaints raised by the tenants regarding the hazards found in their place. The identified hazards include exposed wiring, defect radiators, and etc. Failure of the building's owner to identify and address the fire hazards is also considered as the contributing factor of the fire incident.

Besides that, design of the buildings is critical to mitigate and control the fire in certain extent. For instance, the fire incident in Grenfell Tower, London. Inadequate design and materials of cladding had sped up the spread of fire (British Broadcasting Corporation (BBC), 2017). **Figure 1.3** shown the fire testing of Grenfell Tower since 2005 based on European standard (Symonds, 2021). The Grenfell Tower had failed the fire testing for several times. Cladding is commonly found in the high-rise building which able to improve the strength of the building and protect it from rains and wind. However, the fire will spread extremely fast as the cladding provides a cavity to draw the flames upward externally. This condition is known as stack effect or chimney effect. In terms of design, the cladding supposed should equipped with barriers to seal the gaps in the cavity to prevent flames from further spreading.

Date	Туре	Test fully completed?	Classification			
2005	Cassette	×	•			
2005	Rivet	$\checkmark$	в			
2011	Cassette	×	•			
2011	Rivet	$\checkmark$	B			
2014	Cassette	×	•			
2014	Rivet	$\checkmark$	C			
2015	Cassette	×	0			
2015	Rivet	$\checkmark$	C			
OUICO: CSTR	1		BBB			

Fire testing of Reynobond PE

Figure 1.11 List of fire testing of cladding system (Symonds, 2021)

According to the Department for communities and Local Government in United States (US), the aluminium panel is not a proper material to be used for cladding, especially on buildings exceeds the height of 18m and house chimneys (Ministry of Housing, Communities & Local Government, 2018). Improper selection of the

material can gives impact to the extent of the spread of fire. For instance, aluminium irrigation pipe is not a suitable material to build the chimney flue because it does not have a capability to sustain extreme temperature and cause the fire to spread even quickly (Newsflow, 2021).

# 1.1.3 Effects of Fire

The average duration for the structure fires to occur was every 64 seconds. The fire department of United States (US) had responded about 490,500 structure fires. The casualties involved in the structure fires includes 2,730 death and 13,000 injuries and cause 12.1 billion dollars of property loss as shown in Table 1.1.

Incident Type	Fire	:S	Civilian	Deaths	Civilian	injuries	Proper (In Mil	ty Loss lions) <sup>1</sup>
Fires in California Wildland-Urban Interface (WUI)							\$4,200	(19%)
Structure Fire	490,500	(35%)	2,730	(78%)	13,000	(86%)	\$12,107	(55%)
Residential structure fire	379,500	(27%)	2,630	(75%)	11,900	(78%)	\$8,703	(40%)
Home structure fire	356,500	(26%)	2,580	(74%)	11,500	(76%)	\$8,400	(38%)
One- and two-family home, including manufactured homes	270,500	(19%)	2,230	(64%)	8,600	(57%)	\$6,771	(31%)
Apartment or other multifamily housing	86,000	(6%)	350	(10%)	2,900	(19%)	\$1,629	(7%)
Other residential structure fire	23,000	(2%)	50	(1%)	400	(3%)	\$303	(1%)
Non-residential structure fire	111,000	(8%)	100	(3%)	1,100	(7%)	\$3,404	(16%)
Vehicle Fire	209,500	(15%)	630	(18%)	1,700	(11%)	\$5,170	(24%)
Highway vehicle fire	173,000	(12%)	580	(17%)	1,500	(10%)	\$1,615	(7%)
Other vehicle fire*	36,500	(3%)	50	(1%)	200	(1%)	\$3,555*	(16%)
Outside and Other Fire**	688,500	(50%)	140	(4%)	500	(3%)	\$389	(2%)
Fire outside but no vehicle (outside storage, crops, timber, etc.)	84,000	(6%)					\$210	(1%)
Fires in brush, grass, or wildland (excluding crops and timber) with no dollar loss	277,000	(20%)	••				••	**
Outside rubbish fire	225,000	(16%)	**	**	**	**	**	**
All other fires	102,500	(7%)	**	**	**	**	\$179	(1%)
Total	1.388.500	(100%)	3,500	(100%)	15,200	(100%)	\$21,866	(100%)

 Table 1.1 Reported Fire Occurrences in 2020 (Incident Type)

Source: Fire Loss in the United States during 2020. (NFPA, 2021)

The structure fire is classified into two categories which are residential structure fire and non-residential fire. Based on Table 1.1, the estimated number of residential fires was 379,000, it results in 2,630 fatalities and 11,900 injuries (NFPA, 2021). The total property loss suffered by the victims was 8.7 billion dollars. As compared to the number of cases in 2019, the number of residential fires had significantly increase by 5 percent in 2020 as shown in Figure 1.4 (NFPA, 2021). According to National Fire Protection Association (NFPA), it is believed that the COVID-19 pandemic did

contribute to the rise of fire occurrences because most people tend to spend more time at home (NFPA, 2021). Such circumstance will more or less increase the risk of fire occurrence, as more electrical and heating appliances are being used during that period. Home structure fires had occupied about 356,500 cases over the total number of residential fires and the direct property damage contributed was 8.9 billion dollars (Ahrens and Evarts, 2021).



(NFPA, 2021)

# A. Impact towards environment

Fire can cause adverse impacts toward the environment which can affect the ecological system. United States Environmental Protection Agency (US EPA) defined ecological system as known as ecosystem is a biological community that make up with living organisms such as flora and fauna, humans; as well as non-living things including water, soil, and air (US EPA, 2017a). Both living and non-living things will have a complex interaction with each other without clear boundaries. The example of ecosystem can simply be any forests, lakes, grassland and etc.

However, this ecosystem can be easily destroyed by fire which can not only kill thousands of beautiful creatures, but also pollute the environment. Air pollution is the most observable effect caused by fire. The emission of harmful greenhouse gases such as carbon dioxide and nitrous oxide. This can leads to greenhouse effect and eventually turn up become global warming. Such process occurs when the sun's heat was trapped by the greenhouse gases in the atmosphere and warm up the surface of the earth (Denchak, 2019). Besides that, the pollutants can spread through several pathways and reach the water sources, land and water (Martin, Tomida and Meacham, 2016). This can indirectly causing death of aquatic life and plants.

## **B.** Impact towards social

The increase of air pollution due to fire can affect the air quality of the particular areas. The extent is highly depends on the scale of fire. The pollutants other than greenhouse gases such as particulate matters, chlorinate dioxin and furans, polyfluorinated compounds are another concerns that affect public health (International Organization for Standardization (ISO), 2017). The effect of the poor air quality towards human can range from minor symptoms to more severe ones. The minor symptoms include irritation of eyes and respiratory tract; whereas the severe effects such as lung function impairment, asthma, bronchitis and even death in vulnerable groups. The reason of vulnerable groups are more susceptible to death is due to weaker immune system in elderly peoples and premature group due to incomplete development of immune system (US EPA, 2017b).

Moreover, the smog produced from the fires has high potential to cause haze. As haze is formed by the particulate matters and interact with water contained in the air. This can increase the size of the particulate matters and able to reduce the visibility of surrounding area (ASEAN, 2013). Such condition can increase the number of car accident. As reported in New Straits Times, Director General of Malaysian Institute of Road Safety Research (MIROS) Dr. Siti Zaharah mentioned the car accident could happen due to limited visibility when driving in haze (Bernama, 2019).

## C. Impact towards economic

Fires also affect local economies or even international economies. East Asia Forum reported that Indonesia suffered from approximately 5.2 billion dollars losses in several aspects due to fires. The aspects included agricultural, tourism, transportation,

environmental sectors and industry sectors (East Asia Forum, 2021). The fires affect country's reputation and reduce the tourism as tourists are worried about their own safety and health during travelling as fire is a life threatening event. Therefore, they decide not to take the risk to travel around the country that having frequent fire occurrence. Hence, it reduces the revenue of the particular country and further affect the economic growth.

# 1.1.4 Fire Safety

Fire safety plays critical roles in protecting human's lives as well as mitigate the magnitude of the fire effectively. In this case, there are numerous type of fire protection equipment being launched in the market, so peoples tend to get it easily. As Desiderius said : "Prevention is better than cure", it is a must to install the fire protection system especially in those high-rise buildings, and industries. It is worth to invest in fire protection system as referred to the previous part that discussed about the severe casualties and property losses caused by fires. The most common fire protection system. It works together when the smoke from the fire is detected, the system will trigger the sprinkler system to splash water to the fire source (Mein, 2019).

Fire protection system can be either active or passive. Active fire protection is used to detect, stop, and escape from the fire. The equipment that used in active fire protection system including fire alarm system, fire break glass, fire suppression and sprinkler system, smoke and heat detector, portable fire extinguisher, and etc. The fire alarm system acts as an early warning to buy the time for peoples to evacuate or respond to the fire (Nevada State Fire Marshal, 2012). Whenever the fire alarm system is triggered by fire break glass or smoke and heat detector, the alarm will sound and send the signal to the fire alarm panel. The person can determine the specific location where fire alarm is triggered. Digital alarm communicator has a direct link to the nearest Fire and Rescue Department. The fire suppression system can be in different form depends on the situation, such as foam type, wet chemical, dry chemical and gaseous type (Phoenix Fire Protection Inc., 2017). This is similar as the portable fire extinguishers that classified from class A to class F as illustrated in **Figure 1.5**.



Figure 1.13 Types of fire extinguishers and uses, (Johnson, 2021)

Passive fire protection system mostly used in containing the fire and prevent the spreading of fire. The equipment such as fire doors, fire curtains, fire and smoke dampers and fire compartmentation are used in the passive fire protection. Fire door is important to act as a barrier to resist the fire from further spreading in certain extent by dividing the building into smaller area (FMD, 2019). It can sustain in fire for longer period if the surface is covered with a layer of silver sign plate. According to Uniform Building By-Law (UBBL) 1984, By-law 189 (2), the fire door that are installed in the building should be equipped with automatic door closer, as known as self- closing door (Malaysia and International Law Book Services. Legal Research Board, 1993). Also, it should be inspected and certified by the fire and rescue department and Standard and Industrial Research Institute of Malaysia (SIRIM). The fire protection system should be maintained and tested to ensure its functionality. Plan approach inspection is necessary in order to comply with standards and approved by the Fire and Rescue Department.

Furthermore, most of the organizations should have a proper fire emergency response plan to reduce the impact of fires towards lives, environment, and property. Therefore, Malaysian Fire and Rescue Department (Bomba) does provide fire related education and training to give an insight to the public regarding fire safety in the daily life. The training such as fire drills and use of fire protection equipment including proper way to operate fire extinguisher, use of fire break glass are the most common and basic training conducted among the people.

Fire drills is known as a series of actions to reduce the risk of being trapped in the structure in case fire. Fire drills is important to familiarize the resident with proper escape routes so that they will evacuate to the assembly point in orderly manner. Every structure have different level of risk and casualties that might involve in the fires. It is believed that high-rise building poses higher risk for people being trapped in the structure due to the complex layout. As reported in Dayak Daily, Bomba will not be able to extinguish the fire that occur at 16<sup>th</sup> floor onwards (Sibon, 2019). This is because they do not have the escalator or ladder that high enough to reach the fire point. The Star reported that the Minister of Housing and Local Government Malaysia, Tan Sri Noh Omar mentioned that the fire drills must be conducted annually (The Star, 2016).

In terms of legislation, Government of Malaysia had enacted the laws and enforced the standards related to fire safety. For instance, Fire Services Act 1988, Guide To Fire Protection In Malaysia 2006, and Uniform Building By-Law (UBBL) 1984. As mentioned in section 28 of Fire Services Act 1988, the designated premises are required to apply for fire certificate that issued by the Fire and Rescue Department also known as BOMBA (Malaysia and Lembaga Penyelidikan Undang-Undang, 1998). The premise that considered as designated premise must fulfilled several criteria as illustrated in **Figure 1.6**. University falls within the criteria and considered as the place of assembly whereby the size of building is exceeding 1000 square meters and equipped with central air conditioning system or the population of staffs and students exceed 1000.

No.	Types of	Size of Building	
	Building		
1	Library	Total floor area exceeds 1000 square meters	
2	Hospital and	<ol> <li>3 storeys or above where each floor area exceeds 250</li> </ol>	
	Nursing	square meters	
	Home	ii. 5 storeys or above	
3	Hotel	<ol> <li>Open design balcony approach with open staircase with</li> </ol>	
		extended lobby or tower staircase:	
		<ul> <li>4 storeys or above with more than 50 rooms</li> </ul>	
		<ul> <li>6 storeys or above</li> </ul>	
		ii. Other designs:	
		<ul> <li>21 rooms or above</li> </ul>	
4	Hostel and	<ol> <li>4 storeys or above where each floor area exceeds 250</li> </ol>	
	Dormitory	square meters	
		ii. 6 storeys or above	
5	Office	Height exceeds 30 meter or total floor area exceeds 10,000	A11
		square meters	nlaces in
6	Shop	Total floor area of 2001 square meters or above	Malaysia
7	Factory	<ol> <li>1 storey of 2001 square meters or above with automatic</li> </ol>	malaysia
		sprinkler system	
		<ol> <li>2 storeys where each floor built as separated</li> </ol>	
		compartment single or terrace type construction with total	
		floor area exceeds 1000 square meters	
		III. 3 Storeys or above	
		iv. Flatted factories block development open balcony	
		approach:	
		<ul> <li>2 storeys or above where each compartment size</li> </ul>	
		Exceeds 7000 cubic meters	
		<ul> <li>Special structure.</li> <li>factory complexes such as note all mill complex, note</li> </ul>	
		<ul> <li>lactory complexes such as paint on mill complex, paint oil refinence competitively acta</li> </ul>	
		oli feinery, cement works, etc.	
0	Disco of	Ruildings without a control air conditioning system of 2000	
°	Assembly	<ol> <li>Buildings without a central all-conditioning system of 2000 square meters or above</li> </ol>	
	Assembly	ii Buildings with a central air-conditioning system exceed	
		1000 square meters or with the capacity of 1000 people	
		or above	
9	Storage and	i Underground parking structure exceeds 1000 square	
Ĩ	General	meters	
1		ii. Exceeding 7000 cubic meters	
		iii. 2 storeys or above where its total floor area exceeds 1000	
		square meters	

Figure 1.14 Category of designated premise, (Fesdes, 2021)

Furthermore, UBBL 1984 is enacted under the Street Drainage and Building Act 1974 which stipulated the requirements such as building's structural, construction, fire requirements, and fire protection system and access. Structural requirements cover the building materials to be used, loadings, foundations of the buildings as well as the superstructure (Wong, 2021). The fire requirements and fire protection system specified the design criteria related to fire safety of the buildings such as means for evacuations, rescue, and containment.

#### 1.1.5 Fire Safety in Malaysia

Fire safety is the most critical aspects because fire can results in casualties and catastrophic damages. Hence, the governments had put extra affords in investing the fire safety programmes and emphasizing it to the civilians especially after the fire tragedies (Agus Salim et al., 2021). According to the statistic published by the Department of Statistic Malaysia (DOSM), the number of fire occurrence had shown an increase trend since 2018 to 2019 and started declined in 2020 as shown in Figure 1.7 (Department of Statistic Malaysia, 2020). As reported in New Straits Times, the fire had engulfed an estimated 6000 premises per year nationwide and the damages suffered by the victims are also increase annually (Muhamading, 2016). Other than that, the Fire and Rescue Department reported that there are a total of 38864 calls related to fire has been attended in 2020 with an average of 14 minutes per call (Murugiah, 2021). In addition, the total estimated monetary losses reported was 2.25 billion Ringgit Malaysia in 2020 (Department of Statistic Malaysia, 2020).



Figure 1.15 Number of Fire Occurrences in Malaysia 2010 - 2020

(Department of Statistic Malaysia, 2020)

There are many fire incidents that give significant implication toward peoples and facilities. For example, the fire broke out at 2 branches of tahfiz school which located respectively in Yan and Kampung Dulang Besar, Kedah, as reported by Free Malaysia Today in January 2022 (FMT, 2022). The similar incident also happened in Malay College Kuala Kangsar (MCKK), the fire had destroyed the administrative offices but fortunately no casualty was reported during the scene (Arif, 2021). Another fire incident was reported in July 2020 regarding the fire broke out at the third floor of the Universiti Utara Malaysia (UUM) student hostel. The fire eventually caused an average of 80 percent damages (Bernama, 2021). In November 2021, the blaze had cause massive loss to the owner of Suzuka Autoparts in Taman Segambut. According to Bomba operations commander, the fire had destroyed 90 percent of the shop and no casualties involved in the incident (FMT, 2021).

Malaysian government had started the fire safety campaign since years ago. In educational institution, the Fire and Rescue Department Malaysia (Bomba) had collaborated with the Ministry of Education (MOE) on launching the fire safety programmes in the schools since 2002. For example, a fire safety programme was held in SK Goebilt with the collaboration of BOMBA to educate the students and staffs on the safety matters and perform demonstration on the proper actions to be taken when dealing with fire (Chandra, 2021). In the beginning of year 2022, the Deputy Chief Minister of Sarawak Datuk Seri Dr Sim Kui Hian urged the Bomba to get the civilians to participate in fire safety programmes (Jee, 2022).

## **1.2 Problem Statement**

The higher-education institutions experience an increase number of fire related incidents (United States Fire Association, 2006). There are numbers of possible causes can result in fire occurrences in the campus. For instance, misuse of electrical appliances, short circuit, overloaded extension cords, lack of fire awareness and preparation, negligence, and etc. Hence, it is crucial to educate the occupants on the critical measures to be taken in case of fire.

Universities are categorized under higher-educational institutions that supposed to provide the students with pleasant and conducive learning environment, which leads the students to achieve academic success. Besides, the universities should ensure compliance with relevant requirements and standard, especially on safety aspect (Hassanain, 1998). For example, plan and implement a comprehensive fire safety programmes is known as one of the fire safety measures, including conduct continuous fire safety awareness programmes among the staffs and students, comply to fire safety legislations, fire evacuation plan, and other preventive measures to minimize or even prevent casualties and property losses (Shazrizil Zakaria et al., 2019).

The major problem to be highlighted in this study is the lack of fire safety awareness among the occupants. Even though the government had emphasized the importance of fire safety to the public, but it seems that the public still having low level of fire awareness as reported in the Sun Daily (the Sun Daily, 2016). According to Nestory (2017), the primary causes of fire in the educational institutions are relatively complex and could be started from lack of fire awareness and knowledge. This means that the individual might not aware of the fire hazards, not even to operate the firefighting equipment and fully make use of the resources available on the scene (Nestory, 2017). Such issue had poses dangers to human lives and property loss. Hence, extra effort is needed to enhance the fire awareness among the occupants, so that the occupants can response or evacuate at the first place. Additionally, fire awareness allows the individual to control the fire at the earliest stage before it becomes violent and beyond the control. In short, high level of fire awareness can effectively reduce the adverse consequence caused by the fire.

#### **1.3 Research Objectives**

The aims of conducting this research are shown as follow:

- To determine the level of fire safety awareness among the occupants in UTAR, Kampar Campus.
- 2. To study the relationship between fire knowledge and the level of fire awareness among the occupants in UTAR, Kampar Campus.
- 3. To study the relationship between human factors/ behaviours and the level of fire awareness among the occupants in UTAR, Kampar Campus.
- 4. To study the relationship between fire hazards with its consequences and the level of fire awareness among the occupants in UTAR, Kampar Campus.

## **1.4 Research Questions**

The research questions are shown as follow:

- 1. What is the level of fire safety awareness among the occupants in UTAR, Kampar Campus?
- 2. How does fire knowledge influence the level of fire safety awareness among the occupants in UTAR, Kampar Campus?
- 3. How does human factors in face safety influence the level of fire safety awareness among the occupants in UTAR, Kampar Campus?
- 4. How does fire hazards with its consequences influence the level of fire safety awareness among the occupants in UTAR, Kampar Campus?

#### **1.5 Research Framework**

The variables of this research study are selected based on the variables and results of the past study. According to the study done by Shazrizil Zakaria et al. (2019), the author had selected the level of fire awareness and fire knowledge as the variables to conduct the research. In addition, human factor and behaviours is selected as the variable because the result of the previous study revealed that human factor and behaviours can influence the fire safety measures (Subramaniam, 2004).



**Figure 1.16 Research framework** 

## **1.6 Research Significance**

The fire cases have caused extensive damages and casualties, this research can assist the education sector to give an insight on the importance of fire safety awareness among the occupants in the universities. The outcomes of this study can become a reference for them to conduct future study.

In addition, this research also helps the Safety and Health Consultancy and Fire and Rescue Department in providing useful information to develop a comprehensive fire training material. Apart from that, this study will show the extent of the understanding on fire safety knowledge in university aspects which act as an indicator for the university to evaluate the effectiveness of the fire safety programmes.

Lastly, the occupants will be aware of the fire protective system that being equipped in the building after conducting the questionnaire session. This will create a sense of protective among the occupants and eventually increase the level of fire safety awareness (Sulaiman and Sainsmalaysia, 2006).

#### **CHAPTER 2**

#### LITERATURE REVIEW

#### 2.1 Fire Knowledge

Fire knowledge is referring to any knowledge that is related to fire and the practices that have been established and implemented to protect the surrounding area from being destroy, as well as saving lives (Huffman, 2013). Kupietz (2011) mentioned that fire knowledge can be known as the capabilities of the individual in apply the information based on different scenarios. As observed from the past study, the author will not only evaluate the fire knowledge of the respondents, but also determine the level of fire safety awareness as well (Shazrizil Zakaria et al., 2019).

# 2.1.1 Nature of Fire

Cambridge Dictionary defined fire as the smoke and flames that emits heat and light are produced when combustion occur (Cambridge Dictionary, 2019). Combustion process means the process that involve a series of chemical changes such as exothermic oxidation process which produces heat and visible lights. Fire is the ancient source of energy other than sun. Fire is being used by humans in numerous activities and contribute to civilization. This statement is proven by Professor Ai Sekizawa (Ai Sekizawa, 2004). Civilization refers to a complex human society with its own characteristics of cultural and development of advance technology (National Geographic Society, 2019). The ability of humans to use and control the fire is the key factor that leads them toward civilization (Rogers, 2019). For instance, using fire for cooking and smoke signals for communication purpose.

#### **2.1.2 Fire Ignition Triangle**

Fire ignition triangle is a concept used to understand the essential elements needed for fire to occur. It is impossible for the fire to exist on its own but it can be triggered when three elements are present and react with each other through combustion process. The fire ignition triangle consists of three main components, including oxygen, heat and fuel as shown in Figure 2.1.



Figure 2.1 Fire Ignition Triangle (Scutum, 2013)

Each components have their own function. Heat is the compulsory source to initiate the fire. It can remove extra moisture from the fuel and increase the surrounding temperature. Each materials or fuels have different flash point. The material with lower flash points is known as flammable material which can easily ignite once it reaches its flash point. When the heat warm up the surrounding area, the materials or fuels are preheated during the moment which increase the risk of fire to travel and spread even further (Scutum, 2013).

Fuel is referred to any materials that can be burnt easily when there is fire. The characteristic of fuel can influence the severity of fire, such as the size, quantity, flash point, and arrangement. The example of fuels are papers, woodpiles, rubbers, plastics, chemicals and etc. The fire can be controlled through removal of fuels (Engel, 2017).

The fire becomes more violent when more oxygen is supplied to it. According to the Furer, the oxygen content in the ambient air is around 21 percent, however, the fire

only required 16 percent for burning (Furer, 2021). This means that the environmental condition is favourable for fire to initiate and spread.

# 2.1.3 Fire Tetrahedron

Fire tetrahedron is the modified version of fire ignition triangle. The fourth element, chemical chain reaction is added as the fire researcher found there is a necessary to take it into the consideration (Safelinc, 2011). The elements are arranged in pyramid where the chemical chain reaction is located at the base of the pyramid as illustrated in Figure 2.2. This model is useful when dealing with the fire involve chemicals. According to NFPA, the fire tetrahedron helps in describing the mechanism of fire suppression system to be used to cut off the chain of combustion (NFPA, 2019). A simple example was given by the author regarding the fire involving the reactive metals such as lithium, titanium, and magnesium (Engel, 2017), (Sulaiman and Sainsmalaysia, 2006). In such case, the situation will become even worst if trying to extinguish the fire with water. This will result in temperature increase and explosion due to lithium actively react with water through exothermic reaction (Sulaiman and Sainsmalaysia, 2006).



(Sulaiman and Sainsmalaysia, 2006)

## **2.1.4 Fire Characteristics**

Fire can be prevented by determining its characteristics and understanding the basic knowledges about fire. The fire characteristics are described as follows:

# I. Fire is fast

There is limited response time for peoples to control the fire. The fire can develop into major fire less than 30 seconds (USFA, 2021). The situation might get worse as time passed. The thick smoke will started to fill entire area together with rapid spreading of flames. Since fire is an unexpected events where peoples might not be aware at the first moment, it is absolutely the time for people to escape without carrying any valuable belongings.

# II. Fire is hot

Heat is more life-threatening as compared to flames itself. The internal temperature of the room will gradually rise up to 600 degree Celsius. People may die due to heat shock when expose to extreme heat or cardiac arrest when hot air is being inhaled (Jones, 2010). Besides that, the extreme heat can melts the person clothing causing it to stick on the skin. The entire room will ignite at the same time when the temperature exceeds the flashpoint of everything in the room within 5 minutes (USFA, 2021).

# III. Fire is dark

The dark smoke will produced and dispersed throughout the room in a case fire (USFA, 2021). Such condition will cause the people to take longer time to find the escape pathway as the smoke will totally block their vision. Thus, people are taught to get their body down on the floor and crawl to escape. This is due to the smoke will flow upwards due to hot air (Valkema, 2014).

#### IV. Fire is deadly

Even though fire and smoke are both life-threatening, but the smoke inhalation tend to cause fatality rather than burns. The smoke is considered as killing fumes that consists of particulate matters, vapours and toxic gases. Particulate matters such as particles from incomplete combustion which can penetrate through the barriers in the respiratory system and eventually reach the lungs. These particles can also enter into eyes and irritates the eyes (US EPA, 2013). The vapours produced from the fire is poison and able to absorb into skin which can cause harm to people. Toxic gases such as carbon monoxide is deadly when it enter into bloodstream after being inhaled. It can displace the blood oxygen level and eventually cause death due to carbon monoxide poisoning (US EPA, 2013). The oxygen level in the room will rapidly drop as fire will take up the oxygen for combustion. In fact, people may not be able to make judgement once their oxygen level drop below 17 percent; they can feel dizzy and loss of conscious when the oxygen level at 9 percent and death once it reaches 6 percent (Patrick, 2017).
#### 2.1.5 Stages of Fire

Scheviak suggested that the fire should be suppressed before it is getting more intense if the elements such as heat, oxygen and fuels are available (Scheviak, 2021). In other scenario, the chain of chemical reaction will take into account as well. Most standards had classified the fire into four stages which are incipient, growth, fully developed and decay (Scheviak, 2021), (Josh, 2010). Figure 2.3 shown the 4 stages of fire.



Figure 2.3 4 Stages of Fire with heat release rate over the time

## Stage 1: Incipient

The first stage of fire is incipient where fire can be easily suppressed by using portable fire extinguisher and it can results in minor damage. An incipient fire usually involve small flames which would not spread to other area (Josh, 2010). The smoke can be observed and lower heat emission as compared to the second stage. However, it is possible to cause delay on responding towards the incipient fire manually because it might take longer time to determine the exact location of fire and the fire extinguisher that available nearby (Scheviak, 2021). So, it is important to install the automatic fire suppression systems.

<sup>(</sup>Josh, 2010)

#### Stage 2: Growth

The fire becomes difficult to control when it comes to the second stage, also known as growth stage. The growth of fire depends on the building structures and the resources. The fire gain sufficient oxygen and fuel which causes the fire becomes more violent. The indoor temperature increases and have high potential for flashover to occur. Flashover occurs when the surrounding surfaces are heated until autoignition temperature and explode due to the emission of flammable gas.

### **Stage 3: Development**

When the fire reaches third stage – fully developed, it means that all materials in the room have been totally ignited and the heat released from the fire reach its peak level. During this stage, the fire continuously spread wider causing increase of fire intensity.

### Stage 4: Decay

Lastly, the fire will enter to the final stage – decay stage, where the fire ended. At this point, the fuel and oxygen have been used up by the fire. However, this stage does not mean everything are safe as there might be some non-flaming combustible exist at the scene which has potential to start up another new fire. Other than that, there is a risk of backdraft fire to occur when oxygen is reintroduced to the point (Josh, 2010).

H1: There is significant relationship between fire knowledge and the level of fire safety awareness among the occupants in UTAR, Kampar Campus.

#### 2.2 Fire Safety Awareness among Malaysians

Fire safety awareness means the understanding of knowledges related to fire safety. Fire safety awareness on the other hand is an attitude of the person whether they are aware or conscious with fire hazards that appear at their place. Fire safety awareness among the workers is depends on the management commitments; whereas the fire safety awareness among the civilian usually refer to the efforts and actions taken by the government in emphasizing it. New Straits Times reported that attitude is the main cause of fires in Malaysia (New Straits Times, 2016).

Throughout the years, fire had claimed thousands of lives or suffered from severe injuries due to fire incident. People are being too optimistic by thinking that the fire incident would not happen to them. People with such mindset might not take the fire hazards seriously. According to the research, it was found that the individuals tend to underestimate the risk of fire which resulting in delay actions to cope with fire as the fire is getting more intense (Hooper, Taylor and Pepperdine, 2004). According to the executive director of Henry Butcher Malaysia Low Hon Keong, the level of fire safety awareness among 1.2 millions property owners have yet to satisfy the desirable level (Lum, 2017). He mentioned that among the frequent asked questions from the property owners, none of them asking the questions related to fire safety. Not only that, the property owners even prefer to lock the fire safety access in the building by giving a reason of security issues (Lum, 2017). Moreover, it is a must to stay alert and follow any preventive measures recommended by the fire safety practitioner. Fire risk assessment should be conducted to identify and eliminate the fire hazards by implementing appropriate preventive measures (Beyond Carlton, 2018).

Fire safety awareness is crucial to ensure the ability of individuals in responding fire. The individuals should know the properties of fire and actions to be taken during fire break out. Besides that, fire safety awareness not only can protect the person oneself from fire hazards, but also help those vulnerable groups. Vulnerable groups are referring to a group of individuals that have high tendency need assistance from other peoples (Kuran et al., 2020). For example, pregnant women, elderly, children and other person that unable to take care of themselves. With adequate fire safety

awareness, it allows the individuals to evacuate in safe and orderly manner. Fire safety awareness also allow the individual to learn the correct way to operate fire safety equipment such as fire break glass, sprinkles and fire extinguisher.

## 2.3 Human Factors / Behaviours in Fire Safety

Health and Safety Executive (HSE) defined human factors as a series of interrelated aspects including organizational, job, environmental accompanied with the characteristics of individual which can influence the behaviour and can affect their safety and health (HSE, 2019). Every individual may have their own aspiration, personal goals and intention which can alter their behaviours. The author Chen discovered that human factors is the fundamental cause of fire and explosion accident (Chen et al., 2019). Besides that, human factors are widely involved in the phases of fire development and even in fire protection and evacuation activities. For example, a person who is aware of fire will immediately trigger the fire alarm system, contact the relevant agency, evacuate to the assembly point and perform initial firefighting (Ai Sekizawa, 2004).. Therefore, human factor is the essence of improving the effectiveness of implemented preventive measures as well as emergency response (Sroka, 2019).

The behaviours and way of the individuals in responding to fires can be studied by using four socio-psychological propositions including avoidance, commitment, affiliation, and lastly role. Perhaps, avoidance is the most direct way for individual to mentally protect themselves from any unpleasant circumstances (Fransen, Smit and Verlegh, 2015). The majority tend to find themselves a benign explanations to comfort themselves. During the beginning of the fire, people are psychologically refuse to accept the situation by assuming it as overthinking. This can explain the reason that causing delay in response.

The second proposition is commitment. During the first moment people notice the fire, they often focus on whatever activity they are doing and knowing that the situation is dangerous as they feel committed (Ockerby, 2001). Meanwhile, affiliation can be explained with a simple example. Nobody will start to flee from the fire until their members are all set. For example, parents will not leave their children alone. This is some kind of ethical or moral responsibility imposed to them as they feel they need to take care of their family members, friends and others. The time taken for a group of individuals to evacuate is depends on the slowest individual. For instance, elderly may not able to move faster and possible need others to assist them. The group might take longer time to flee. The last proposition to be discussed is role of the occupants in the building that can influence the effectiveness of emergency response. This preposition is helpful to explain the response of the individual based on their daily duties. For instance, the visitors or outsiders of the buildings have higher risk to get trapped as compared to the residents of the building in case of emergency. The reason is due to unfamiliar building structures and layout which cause them to determine the correct escape route.

According to the author, the contributing factors that influence the fire safety behaviours and lifestyle of students in the Malaysian higher-educational institution are predisposing factors, reinforcing factors and enabling factors (refer to Figure 2.4) (Subramaniam, 2004). Predisposing factors means the individuals characteristics include demographic (gender and age) and social factors that influence their capability of self-protective behaviours (Lilienthal et al., 2016). The social factors such as knowledge, attitudes, ethnicity, beliefs, values and perceptions. These factors are the concept to motivate the person for a specific behaviour. In contrast, reinforcing factors usually involve reward and punishment approach based on the behaviour (Mohamed Yusof et al., 2021) (Subramaniam, 2004). For example, receiving performance feedbacks, any social approval and disapproval are considered as reinforcing factors. Enabling factors are referring to the aim of environmental aspects which can either promote or hinder self-protective actions of the individual (Mohamed Yusof et al., 2021). Enabling factors are known as the preceding factors of behaviours to achieve the aspiration. All fire protection resources, policies and skills should make available to improve the awareness and self-protective behaviour.





Source: (Subramaniam, 2004)

H2: There is significant relationship between human factors/ behaviours and the level of fire safety awareness among the occupants in UTAR, Kampar Campus.

#### **2.4 Fire Hazards with its Consequences**

Fire hazards is defined as the source that has potential to poses danger situation when there is fire. According to Safeopedia, the fire hazard is an event that involve flames which either increase probability of uncontrolled fire occurrence, or increase its severity (Safeopedia, 2021). The fire hazards can be simply a fuel which can be easily ignited by its own such as defected electrical appliances. The potential fire hazards are including electrical hazards, appliances produced heat, open burning, flammable and oxidizing chemicals , and etc.

As mentioned in Chapter 1, fire can bring negative consequences towards humans, ecological system, environment, and economic. However, peoples tend to overlook the fire hazards that can be discovered in our daily life (Judd Fire Protection, 2020). For instance, dust, loose sockets, accumulation of garbage, improper, handling and storage of flammable materials and etc. The reason somehow related to the fire awareness of the individual.

H3: There is significant relationship between fire hazards with its consequences and the level of fire safety awareness among the occupants in UTAR, Kampar Campus.

#### 2.5 Fire Safety Management

In case of fire occurrence, individuals are required to make quick decision on either putting off the fire or evacuate due to time restriction. If the fire is not controlled, more casualties may involve in the incident. Therefore, fire safety management is ultimately important in protecting lives, environment and property by effectively control the situation. When an effective fire safety management in place, it will probably leads to satisfactory outcomes including minimize insurance premium, business interruptions, improve customer satisfaction as well as the reputation (Agyekum, Ayarkwa and De-Graft Joe Opoku, 2016), (Della-Giustina, 2014).

Fire safety management is a planned system to implement, control, monitor, and review the fire safety standards (Mohamed Yusof et al., 2021). The procedures and actions to be taken for people in managing fire safety are clearly stated in the fire safety plan. This plan serves as the guidelines fire the person to deal with fire and it should be strictly implemented to prevent fire occurrence and protect people and property. According to the author Mohamed Yusof and Howarth, manager is accountable in the fire safety management by applying fire safety related policy, standards, information, knowledge and practices to the tasks such as conduct evaluation and control the fire occurrence (Mohamed Yusof et al., 2021), (Howarth and Kara-Zaitri, 1999).

In general, fire safety management consists of five system. System 1 involve implementing the fire safety policies and installing fire protective equipment on relevant aspects; system 2 is coordination of program and the operations in system 2 and system 3; system 3 is to maintain the fire risk within an acceptable range by conducting fire safety audit; the activity involve in system 4 is develop the fire safety solutions; and system 5 is promoting fire safety policies. In 2018, Ebenehi has utilized the audit model for fire safety management (Figure 2.5) to develop his conceptual framework (Ebenehi et al., 2018). The audit model involved a series of activities such as Plan-Do-Check-Act (PDCA) to evaluate the existing fire safety management system. Figure 2.6 depicts the critical elements of an effective fire safety management system.



Figure 2.5 Audit Model: Fire Safety Management (Ebenehi et al., 2018)



Figure 2.6 Effective Fire Safety Management System (Ebenehi et al., 2018)

Indeed, failure to implement the fire safety management plan will greatly increase the likelihood of fire tragedy occurrence. An effective fire safety management can be directly attributable to how well the application of fire safety knowledges and policies. Thus, a comprehensive fire safety activities such as drills must be conducted and the fire protection equipment should make available and accessible to people in case fires. Likewise, maintenance of fire protective equipment is important to ensure its functionality. Fire insurance is necessary to insure the direct losses suffered by the victims (Agyekum, Ayarkwa and De-Graft Joe Opoku, 2016), (Ramachandran, 1999). According to Gabriel (2021), the outcome of the survey done by Zurich Malaysia shows that there are 59 percent of Malaysian homeowners do not have fire insurance (Olano, 2021). This indicates that the victims will even suffer in getting budget to repair their home and other expenses.

## 2.5.1 Evaluation of Fire Safety

Fire protection plan should be reviewed annually and updated when necessary. It helps to identify the deficiency of the implementing control measures and compare the effectiveness of improvements by referring the baselines. On the other hand, there is necessary to re-evaluate the fire protection plan when any changes ae subjected to the legislation, new hazards arise, resources, organizational structures and being directed by the Director General of Bomba Malaysia. Therefore, a comprehensive fire risk assessment (FRA) should put in place to help on decision making and ensure the coverage of the current fire protection plan.

# 2.5.2 Fire Risk Assessment

Fire risk can be expressed by using a formula that utilized in the fire risk assessment (FRA), which is the likelihood of fire occurrence multiply by the severity of fire (Locke, 2013). Severity is referring to the harm potential as known as harm consequences of fire which shown in Figure 2.1. The example of harm potential are fatality, the extent of property damages and fire spread.

FRA is utmost critical component of the fire risk management (Akashah, Timothy and Shing, 2017). The purpose of conducting FRA is to review existing plan, assess the fire risk, and lastly provide constructive recommendation. There is no comprehensive and perfect fire risk assessment method (Arsic et al., 2020). The FRA procedures should be planned and tailored to the needs and fire risks in the structures. Hazard analysis and assessment consists of hazards identification and its risk level, performance baselines, as well as corrective or preventive actions. FRA usually correlated with the several documentations such as relevant legal requirements and

guidelines. The outcome of the FRA should be documented for future reference and evaluation purpose. FRA required to fulfil 5 main steps as prescribed by Department for Communities and Local Government (DCLG) as shown in Figure 2.7 (Department for Communities and Local Government, 2006).



Figure 2.7 5 Steps of FRA

(Department for Communities and Local Government, 2006)

The first step of FRA is fire hazards identification, where the assessor will perform inspections, brainstorm and foresees the potential fire hazards at the particular place. The essential elements stated in fire ignition triangle such as fuel, oxygen, and heat will be identified, as these elements have potential to influence the intensity of fire.

As mentioned earlier, there are numerous people suffered from injuries and even death in fire tragedies. Thus, the individuals expose to risk should take into account when conducting FRA. The individuals who are considered at risk are the person who is unfamiliar with the layout, vulnerable group such as children, elderly and pregnant women, live near the fire danger such as electrical room, and persons with disabilities (Locke, 2013).

The third step of FRA is to assess the fire risk based on the information obtained from previous steps. The adequacy of existing fire preventive measures and fire protection equipment such as fire detectors, fire communication panels and fire sprinkles are analysed accordingly, so that the existing fire equipment is sufficient to deal with fire (Department for Communities and Local Government, 2006). The time taken for peoples to completely escape from the building is observed to determine any improvements can be done in shortening the time to flee. Besides that, the evacuation routes in the fire protection plan is reviewed to ensure it is clearly labelled. The fire risk can be calculated by using the fire risk assessment matrix (Figure 2.8) which is slightly similar as Hazard Identification Risk Assessment and Risk Control (HIRARC) for occupational safety and health . Once the fire risk level is obtained, the action to be taken can be determined by referring to the table of action level and timescale as illustrated in Figure 2.9. Prompt actions should be taken in order to reduce the risk when it reaches substantial risk onwards.

		Fire Risk R	ating			
The	e fire risk rating is calcul combi	ated using the following ined results for likelihood	risk matrix table, taking i land consequences.	nto account the		
	Rick	Pot	Potential Consequences of Fire			
	Matrix	Slight Harm (1)	Moderate harm (2)	Extreme harm (3)		
Fire	Low (1)	Trivial Risk	Tolerable Risk	Moderate Risk		
ihood of Occurring	Medium (2)	Tolerable Risk	Moderate Risk	Substantial Risk		
Likel	High (3)	Moderate Risk	Substantial Risk	Intolerable Risk		

Figure 2.8 Fire Risk Rating (Pocket Survey Ltd, 2022)

	Risk Level	Action required and timescale
ſ	Trivial	No action is required and no detailed records need be kept, however the situation should be monitored regularly.
	Tolerable	No major additional controls required, however the situation requires ongoing monitoring and there may be a need for consideration of improvements that involve minor or limited cost.
		It is essential that efforts be made to reduce the risk. Risk reduction measures should be implemented within a defined time period and ongoing monitoring is required.
	Moderate	<b>NOTE!!</b> Where moderate risk is associated with consequences that constitute extreme harm, further assessment may be required to establish more precisely the likelihood of harm as a basis for determining the priority for improved control measures.
	Substantial	Considerable resources may have to be allocated to reduce the risk. If the building is unoccupied, it should not be occupied until the risk has been reduced. If the building is occupied, urgent action should be taken.
	Intolerable	Building (or relevant area) should not be occupied until the risk is reduced.

# Figure 2.9 Risk level and timescale for action

(Locke, 2013)

After that, any tasks involve planning, recording and implementing will be performed in step 4. The emergency response plan is developed based on the recorded findings and recommended action of assessment. A group of relevant personnel is appointed to handle the works related to fire safety management include implementation and conduct trainings. Fire drills should be conducted to familiarize the peoples especially the emergency response team with the emergency response plan. The last step of FRA is to review the assessment to determine the short-coming of the existing plan.

#### 2.5.3 Fire Safety Measures

The function of fire prevention systems, fire protection systems, and fire suppression systems varies and serve for different purposes. Fire prevention systems is generally necessary to reduce the potential fire occurrences by referring to the hazards and its severity of the fire, so that the likelihood of severe fire remains low. The actions that can be taken to prevent or reduce the risk of fire are take extra care on ignition points in the building, and store the combustible substances in a safe manner. The fire hazards can be identified by conducting periodic fire safety inspections and risk assessment (Brady, 2019).

Fire protection system is used to protect the occupants from danger and reduce the damage caused by the fire. The main purpose is to provide sufficient means for occupants to evacuate safely, and reduce the cost needed for repair works. There are three types of fire safety systems, which are fire protection system, fire suppression system and fire prevention system. Each of them serve in different ways. As mentioned in Chapter 1.1.4 Fire Safety, active fire protection system usually take part in detecting and fight the flames such as smoke detectors, fire alarms, and fire sprinkles to act as early warning and response (Brady, 2019); whereas passive fire protection system is to prevent the spread of fires and smoke throughout the space. The example of passive fire protection system is compartmentation whereby the flames and smoke can be blocked by the fire door.

Fire suppression system is known as the final fire safety measures to cool down the surrounding area and control the fire (Nolan, 2011). The substances such as carbon dioxide and inert gas are released to suppress the fire once the fire suppression system is being triggered. Fire suppression system often used dry chemical agents as the materials instead of fire. Hence, it is suitable for those places with items that susceptible to water damage, for example server room that contains electrical appliances, and other storage room of valuable materials.

In short, fire prevention system is used to reduce the potential fire hazards; fire protection system serves to minimize the damages and assist the overall evacuation plan; and fire suppression system should be equipped to fight the blazes.

## 2.5.4 Fire Safety Program

A written fire safety program outlines the plans and services that used to mitigate the risk of fire that can cause serious casualties and property damages (University of Chicago, 2017). The aim of fire safety program is to comply with fire safety standards and create a safety culture among the individuals which can be achieved by raising their fire safety awareness. A comprehensive fire safety program consists of several crucial elements which are fire hazard identification, develop fire safety plans and policy, provide adequate education and training, installation of fire protection system as well as the responsibilities of relevant person especially the fire marshal and response team (The American Underwriters Inc, AEU, 2018).

Fire safety training should be designed based on the target groups, type of building and its uses (Vector Solutions, 2015). The training usually is more specific to the type of operations; for educational institution and residential building, the training contents will be more general and easy to understand. For instance, fire extinguisher training and fire drills. For example, the fire brigade has organized a training in Dugri market to promote the coming fire safety week which is helpful in improving the fire safety awareness among public (refer Figure 2.10) (The Times of India, 2022). The purpose of training is to educate people on necessary actions to be taken in case of fire occurrence as well as the fire arrangements.



Figure 2.10 Fire Brigade India organized fire safety training (The Times of India, 2022)

Fire hazard identification can be done either through periodic inspections or feedbacks obtain from peoples. The main focus of fire hazard identification is to determine the unsafe conditions of the surrounding areas which can affect the effectiveness of firefighting and evacuation during emergency. Fire safety inspection is conducted to capture the weaknesses of the implemented control measures, so that prompt action will be taken to adjust or amend the action plan (Locke, 2013). Such approach can mitigate the risk or fire occurrence and recurrence (United States Department of Labor, 2021). The inspection report must be drafted out and documented for future reference.

# **CHAPTER 3**

# METHODOLOGY

## 3.1 Overview

The research methodology is designed based on the relevant literature reviews to achieve the objectives of the research. The items will be discussed in this chapter are research design, sampling method, data collections, methods, and instrument used or data analysis.

# 3.2 Research design

The aim of the study is to identify the level of fire safety awareness among the occupants. The data collection for this study is by distributing designed questionnaires through quantitative approach. The questionnaires will be distributed through several platforms such as Microsoft Team, email, WhatsApp, etc. The consent from the responders will be obtained before they can proceed to insert the demographic details and other questions. SPSS26 is utilized for data analysis.

### **3.3 Sampling Method**

## 3.3.1 Target Population

The target population of this study is the occupants such as students and staffs in Universiti Tunku Abdul Rahman (UTAR) Kampar Campus. As mentioned in Section 1.2 Problem Statement, the number of campus fire had showing positive trends throughout the years.

## 3.3.2 Sample Size

As mentioned in section 3.2.1, the occupants in UTAR Kampar Campus are targeted to conduct this study. The total population in UTAR Kampar Campus is 10,938, that including 950 of UTAR academic and administrative staffs, and 9,988 students. The sample size is determined by using an online software called Raosoft. The margin of error is set at 5 percent with the confidence level of 95 percent.

#### **3.3.3 Sampling Location**

The research is conducted among the occupants in UTAR, Kampar Campus only. The campus is located at Jalan Universiti, Bandar Barat, 31900 Kampar, Perak and its coordinate is 4.334838, 101.135141.

## **3.4 Scale Measurement**

The purpose of this study is to identify and explore the level of fire safety awareness and knowledge among the occupants in UTAR, Kampar Campus. Semantic Differential Scale as known as 5 point Likert scale is utilized to obtain the opinions from respondents measure the variables. The 5 point Likert scale is range from 1 (strongly agree) to 5 (strongly disagree). The reason of using 5 point Likert scale is because the authors in past study are also utilized it to obtain desired responds from the respondents (Shazrizil Zakaria et al., 2019), (Mkharem, Adam and Supeni, 2018).

#### **3.5 Research Instruments**

## **3.5.1 Questionnaire Design**

In this study, questionnaire is employed to obtain the information required. The language of the questionnaire is in English. The questionnaire is constructed with simple and understandable sentences to ensure the respondents manage to provide precise feedbacks. This is helpful in obtaining desirable results. The questionnaire will be distributed through online to all occupants such as staffs and students in UTAR, Kampar Campus. A brief introduction on research topic will be clearly stated in the beginning of the questionnaire to enhance the respondents' understanding about the research.

The questionnaire consists of five sections which are demographic information of respondents, level of fire safety awareness, fire safety knowledge, human factors, fire hazards and its consequences. Section A is the first section of the questionnaire. The respondents are required to fill in their demographic information such as age, gender, educational status, employment status, and faculty. The questions related to fire safety awareness and knowledge are addressed in Section B and Section C. Whereas the question related to human factors, and fire hazards with its consequences are listed under Section D and Section E.

## 3.5.2 Pilot Test

Pilot test will be conducted to enhance the quality of the questionnaire to minimize the errors and uncertainty results. The drafted questionnaire will be distributed to the UTAR students from different faculties. Feedbacks from the respondents are collected to modify the contents and structure of the questionnaire. Such approach allows the researcher to provide clear instructions for each questions and ensure all respondents are manage to answer the questions accordingly.

# **3.5.3 Ethical Consideration**

In terms of ethical, the individual who is chosen as the respondent has the rights to decline participation. This means that the consent from the respondents will be obtained prior the session. Moreover, the researcher held accountable in keeping the personal information of the respondents private and confidential. The data obtained from the questionnaires will not share to the outsider and mainly for research purpose only. Any unacceptable, discriminatory, or offensive languages are strictly prohibited and avoided in the questionnaire.

# 3.6 Data Analysis

Statistical Package for the Social Science (SPSS) 26 is utilized to measure and calculate the data obtained in this research. The data for each section will be illustrated and analysed by using Descriptive Analysis. The data is calculated statistically on the impact of the variables which are fire safety awareness, knowledge, human factors, as well as fire hazard and its consequences towards the level of fire safety awareness. After that, the variables will undergo the reliability test as known as Cronbach Alphas value test, which has been similarly done by the researcher, Mufida Mkharem in determining the level of fire awareness and knowledge among the occupants of residential houses in Libya (Mkharem, Adam and Supeni, 2018).

#### **3.7 Validity and Reliability Test**

The concepts of validity and reliability are widely used to ensure the quality of the research study (Middleton, 2019). It is ultimately important for research design, planning, as well as the results writing of the quantitative research (Middleton, 2019). A definition of reliability is given by Edwin (2019) who describes the extent to which the outcomes of the data analysis is always consistent even the researcher repeat the study. Validity is the extent to which the accuracy of the results that are being measured by the instrument (Edwin, 2019).

Cronbach's Alpha is known as the most reliable method that widely used to estimate the reliability of the variables. This method was found in 1951 by a psychology professor called Lee Joseph Cronbach (Alexander, 2001). According to Ursachi, Horodnic and Zait (2015), the consistency of the instrument is based on the correlation between the variables under the same study. In general, the Cronbach's Alpha value is determined by using the formula as shown below:

$$\alpha = \frac{N \times \bar{c}}{\bar{v} + (N-1) \times \bar{c}}$$

Where,

N = Number of items

 $\bar{c}$  = Average covariance between item pairs

 $\bar{v}$  = Average variance

(Glen, 2021)

The reliability acceptable range of the Cronbach's Alpha value is 0.6 to 0.7, whereas 0.8 onwards is considered as good results. However, it does not mean the values greater than 0.95 are totally the excellent results as it might be due to item redundancy, lengthy scales and etc. (Farahiyah Akmal Mat Nawi et al., 2020). If the values fall below 0.6, this indicates that the variables does not interrelated with each other (Tavakol and Dennick, 2011).

In this study, the Cronbach Alpha value of three variables including fire hazards, human factors in fire safety, and fire hazards with its consequences are determined by using SPSS software.

# **CHAPTER 4**

# **RESULTS AND DISCUSSION**

# 4.1 Overview of Data Analysis

This chapter has analyzed the data obtained from the questionnaire. There are 387 responses being collected which has been reached the target sample size. These data will be retrieved from the Google Form and analyzed by using SPSS software. SPSS software is applicable to numerous sectors, such as quaternary sector, marketing, and many more sector that involving data analysis or survey. SPSS software is commonly utilized to organize, manage, and analyze the complex data. It is also helpful in ensuring the accuracy and quality of the statistics, as well as the decision making of the researcher (Alchemer, 2021). This software was first launched by a company called SPSS Inc. in 1968 and was then owned by IBM in 2009 (Alchemer, 2021). The data analysis consists of descriptive analysis and Pearson Correlation Coefficient.

## 4.2 Cronbach's Alpha Results

Based on the result illustrated in Figure 4.1, Figure 4.2 and Figure 4.3, the Cronbach's Alpha results for level of fire awareness, fire knowledge and fire hazards with its consequences are good, with the value of 0.804, 0.828 and 0.835 respectively, which means the strength of association between the items and variable are strong. However, the Cronbach's Alpha value for human factors in fire safety as depicts in Figure 4.4 falls within the acceptable level which is 0.665, meaning that the strength of association between the items and variable are strong.

Reliability Statistics						
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items				
.804	.805	6				

Figure 4.1 Cronbach's alpha result for the variable: Level of fire awareness



Figure 4.2 Cronbach's alpha result for the variable: Fire knowledge



Figure 4.3 Cronbach's alpha result for the variable: Fire hazards with its consequences



Figure 4.4 Cronbach's alpha result for the variable: Human factors in fire safety

#### **4.3 Descriptive Analysis**

According to a definition provided by Ayush Singh Rawat (2021), descriptive analysis is a type of data analysis to show and summarize the large volume of data in an organized manner, so that the researcher can easily understand, observe the patterns of the data, and interpretation of data. Descriptive analysis is a prior process of the statistical analysis. It describes the features or distribution of the given data set in the study (Trochim, 2020). The demographic data is considered as categorical variables are presented in several ways, such as histogram, pie charts and etc. (Trochim, 2020).

### 4.4 Demographic Analysis

Demographic analysis can broadly be defined as a population-based study on the factors such as ethnic, age, gender, and etc. (Hayes, 2021). In general, demographic data is also referring to the socioeconomic information that is statistically presented to show the education level, employment, and more (Hayes, 2021). The questionnaire is started with Section A which is demographic information. The demographic data obtained in this study are gender, age, ethnic, level of study, position, and faculty.

# 4.4.1 Gender



Figure 4.5 Pie chart for gender of respondents

Figure 4.5 depicts the proportion of gender based on 389 respondents. From the pie chart, the proportion of female respondent is 53 percent, which is 208 respondents; whereas the proportion of male respondent is 47 percent, which is 181 respondents out of 389 respondents. In shorts, the female respondents occupied the most proportion which is 3 percent higher than male respondents. Hence, female respondents are more responsive as compared to the male respondents.



Figure 4.6 Pie chart for age of respondents

Figure 4.6 illustrated the percentage of respondents based on six age groups. The respondent within the age of 21 to 25 years old is having the highest percentage which accounted for 46 percent (181 respondents), and followed by the respondent with the age below 20 years old which comprised 41 percent (158 respondents). In addition, the respondent within the age of 31 to 35 years old and 36 to 20 years old are having the same percentage which accounted for 3 percent, and followed closely by the respondent within the age of 26 to 30 years old at 2 percent. Thus, the highest proportion of responses are obtained from the respondent within the age of 21 to 25 years old, whereas the respondents age ranging between 26 to 30 years old comprised the least percentage which is 2 percent.

# 4.4.3 Ethnic



Moreover, Figure 4.7 shows ethnic of respondents in UTAR, Kampar Campus. Based on the pie chart, the majority of respondents are Chinese which consists of 89 percent (348 respondents). There are 5 percent of respondents are Indian and followed closely by respondents with an ethnic group of Malay at 4 percent, while there are only 2 percent of the respondents with other ethnics, such as Japanese and Kikuyu in Kenya.

## 4.4.4 Level of Study



The given pie chart in Figure 4.8 provides the information about the distribution of the level of study of the respondents. The largest category of the educational level was degree, which accounted for 81 percent of the total population. In stark contrast, the level of study with the lowest percentage is diploma, which comprised a tiny 1 percent out of the total sample size. In addition, those with level of study of foundation contributed 7 percent, PhD made up 6 percent and followed by master which is 5 percent.

# 4.4.5 Position



Furthermore, Figure 4.9 displays the position of the respondent that consists of student, UTAR academic staff, and UTAR administrative staff in percentage. The largest proportion of respondents are students, which accounted for 88 percent. In contrast, UTAR academic staff represents a 11 percent portion which is 10 percent higher than the UTAR administrative staff at 1 percent.

### 4.4.6 Faculty



**Figure 4.10 Pie chart of faculty** 

The pie chart shows in Figure 4.10 provide information on the respondents according to faculties. As referring to Figure 23, the proportion of the respondents from Faculty of Science (FSc) is the same as Faculty of Business and Finance (FBF) which accounted for 25 percent. Likewise, the percentage of the respondent from Faculty of Engineering and Green Technology (FEGT) is similar with Faculty of Arts and Social Science (FAS). The respondents from Faculty of Information and Communication Technology (FICT) comprised of 20 percent of the population. On the other hand, responses from centre for Foundation Studies (CFS) accounted for 8 percent, whereas Institute of Chinese Studies (ICS) contributed a tiny 2 percent of the total population.

### 4.5 Data Interpretation

### 4.5.1 Questionnaire responses: Level of fire safety awareness

		Percentages (%)				
No.	Item Description	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	I am aware of the danger of the fire occurrence.	0.0	2.0	13.0	42.0	42.0
2.	I am aware of the nearest location of the fire extinguishers, fire break glass alarm or fire hose reels.	4.0	18.0	26.0	34.0	19.0
3.	I am aware of the location where fire evacuation floorplan is available and the assembly area.	5.0	19.0	29.0	27.0	20.0
4.	Fire safety is always my concern.	2.0	9.0	26.0	36.0	26.0
5.	I know what to do in case of fire happens.	1.0	10.0	26.0	41.0	23.0
6.	I am aware of the potential ignition points and sources of fire.	3.0	10.0	28.0	37.0	23.0

Table 4.1	Questionnaire responses:	Level of fire awareness
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Based on Table 4.1, it is observed that majority if the respondents are aware of the danger of fire occurrence in the daily life, such as fire evacuation floor plan, fire extinguishers, fire break glass and etc. Most of the respondents are concern about fire safety and aware about the potential sources of fire. There is 29 percent of the population hold the neutral view of the statement regarding the fire evacuation plan and the assembly area. This means that the respondents are not sure or familiar with the location of the evacuation floorplan and the assembly area in the facilities.

# 4.5.2 Questionnaire responses: Fire knowledge

		Percentages (%)				
No.	Item Description	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	I know how to operate a portable fire extinguisher effectively.	7.0	23.0	29.0	27.0	14.0
2.	I understand the concept of fire triangle / fire tetrahedron.	18.0	28.0	25.0	18.0	11.0
3.	I have participated in fire drills or any fire safety programme.	8.0	14.0	22.0	33.0	22.0
4.	I know the purpose and function of the fire emergency response team and plan.	5.0	9.0	27.0	36.0	24.0
5.	I am familiar with the stages of fire development.	8.0	28.0	32.0	20.0	12.0
6.	I know that the type of fire extinguisher to be used is depending on the types / classes of fire.	10.0	20.0	27.0	26.0	18.0

Table 4.2	Ouestionnaire	responses:	Fire	knowledge
	Zuconomiun c	i coponoco.	Inv	monicase

The responses of Section C of the questionnaire are shown in Table 4.2, majority of the respondents are having moderate knowledge related to fire. There is more than 30 percent of the population do not know or not familiar with the operation of fire extinguishers. In addition, it seems that the respondents are having slight understanding about the concept of fire tetrahedron and stages of fire development. In contrast, most of the respondents are used to participate in fire safety programmes.

### 4.5.3 Questionnaire responses: Human factor/ behaviour in fire safety

		Percentages (%)				
No.	Item Description	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	If I hear the fire alarm, I will stop my work and escape immediately.	1.0	3.0	11.0	36.0	49.0
2.	When the fire alarm is triggered, I will feel panic and find difficulty in escaping from the building / environment that I am not familiar with.	14.0	24.0	25.0	26.0	11.0
3.	In case of a fire, I will wait for my colleagues / family / friends before fleeing from the building.	9.0	18.0	29.0	31.0	13.0
4.	If I discover a fire, I will leave the building immediately without triggering the fire alarm.	30.0	32.0	20.0	9.0	9.0
5.	When the fire alarm is triggered, I will simply assume it is a false alarm.	24.0	31.0	24.0	12.0	9.0
6.	If I know that a fire drill is being conducted, I will not treat it seriously.	22.0	32.0	23.0	14.0	10.0

## Table 4.3 Questionnaire responses: Human factor/ behaviour in fire safety

According to Table 4.3, majority of the respondents will stop their work and evacuate when the fire alarm is triggered. Besides that, the respondents hold the perspective saying that they do not simply assume the sounded alarm is a false alarm. However, there is small proportion of the respondents with the opposite perspective. In the case of fire, the respondents mentioned that they will trigger the fire alarm to alert other peoples before escape.

# 4.5.4 Questionnaire responses: Fire hazard with its consequences

		Percentages (%)				
No.	Item Description	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	I know the purpose of conducting fire risk assessment.	1.0	3.0	18.0	44.0	34.0
2.	I know that cigarette is one of the major causes of the fire that claimed numerous lives.	1.0	4.0	13.0	38.0	44.0
3.	I understand fire hazards can increase the risk of fire occurrences and pose adverse impacts / casualties.	0.0	2.0	12.0	46.0	41.0
4.	I know that overloading extension wires and sockets can increase the risk of fire occurrences and explosions.	0.0	2.0	8.0	37.0	52.0
5.	I know that flammable / combustible substances should be kept away from the source of ignition (electrical, heating appliances).	0.0	2.0	9.0	32.0	57.0
6.	I know that waste accumulation is one of the fire hazards that can results in rapid spread of fire.	1.0	4.0	17.0	37.0	40.0

# Table 4.4 Questionnaire responses: Fire hazard with its consequences

This section shows the perspective of the respondents regarding the fire hazards with its consequences. This is to evaluate the understanding of the respondents on the cause and effect relationship of the fire hazards. As depicted in Table 4.4, the majority of the respondents know the potential fire hazards and activities that can increase the risk of fire occurrence.
#### 4.6 Pearson Correlation Coefficient

Pearson correlation coefficient was founded by an English academic and mathematician called Karl Pearson (Kenton, 2022). Pearson correlation follows the concept of chi-square test, determines the p-value of the variables, develops the linear regression as well as classifies its distribution. The main purpose of conducting Pearson correlation testing is to measure the strength between two continuous variables. Another reason is to determine whether the relationship between two variables is statistically significant. The Pearson coefficient ranges from -1 to +1. If the value shows -1, this indicates that the variables are negatively correlated, whereas the value +1 indicates there are positive relationship between the variable (Kenton, 2022). In contrast, value 0 represents no relationship (Kenton, 2022). As calculation of Pearson correlation is time consuming and complicated, the researchers prefer to compute their data by using SPSS (Nickolas, 2021).

In this study, Pearson correlation is utilized to determine whether there is strong relationship between the level of fire safety awareness with three variables, which are fire knowledge, human factors/ behaviours in fire safety, and fire hazards with its consequences.

#### 4.6.1 Pearson Correlation Coefficient with Fire Knowledge

		Total Sum Fire Awareness	Total Sum Fire Safety Knowledge
Total Sum Fire Awareness	Pearson Correlation	1	.645**
	Sig. (2-tailed)		
	Ν	389	.000
Total Sum Fire Safety Knowledge	Pearson Correlation	.645**	1
	Sig. (2-tailed)	.000	
	Ν	389	389

Table 4.5 Pearson correlation results about fire knowledge

\*\* Correlation is significant at the 0.01 level (2-tailed)

Table 4.5 depicts the result of the Pearson correlation testing related to the relationship between level of fire awareness and fire safety knowledge. The Pearson correlation value, r is 0.645 with the p-value as known as significant value of less than 0.01 [r=0.645, n=389, p<0.00]. Therefore, there is strong positive correlation between two variables. This indicates that the level of fire awareness is highly depends on the fire safety knowledge of the individual.

#### 4.6.2 Pearson Correlation Coefficient with Human Factors in Fire Safety

		Total Sum Fire Awareness	Total Sum Human Factors in Fire Safety
Total Sum Fire Awareness	Pearson Correlation	1	0.039
	Sig. (2-tailed)		.444
	Ν	389	389
Total Sum Human	Pearson Correlation	.039	.389
Safety	Sig. (2-tailed)	.444	
Salety	Ν	389	389

Table 4.6 Pearson correlation results about human factors in fire safety

According to Table 4.6, the Pearson correlation value, r of human factors in fire safety is 0.039, with the significant value of 0.44. [r=0.039, p<0.44, n=389]. Hence, there is no correlation between the level of fire awareness and human factors in fire safety. In other words, the level of fire awareness is not influenced by human factors.

#### 4.6.3 Pearson Correlation Coefficient with Fire Hazards with Its Consequences

		Total Sum Fire Awareness	Total Sum Fire Hazards with its Consequences		
Total Sum Fire	Pearson Correlation	1	.399**		
Awareness	Sig. (2-tailed)		.000		
	Ν	389	389		
Total Sum Fire Hazards with its Consequences	Pearson Correlation	.399**	.389		
	Sig. (2-tailed)	.000			
	Ν	389	389		

Table 4.7 Pearson correlation results about fire hazards with its consequences

\*\*. Correlation is significant at the 0.01 level (2-tailed)

The results of Pearson correlation testing of the variables regarding the relationship between the level of fire awareness and fire hazards with its consequences is shown in Table 4.7. The Pearson correlation value is 0.399, followed with the significant value of 0.00 [r=0.399, p<0.00, n=389]. Thus, there is strong positive correlation between two variables. Therefore, the level of fire awareness is highly influenced by the fire hazards with its consequences.

#### 4.7 Summary

To sum up, this chapter includes the analysis of the data collected via Google form. SPSS software is utilized to perform descriptive analysis and Pearson correlation testing. The results obtained for each variable are interpreted and analyzed respectively. As refer to the results of descriptive analysis, most of the respondents are within the age of 21 to 25 years old. For information related to gender, female respondents have made up 53 percent of the population. In terms of position and level of study, the responses collected from students has accounted for 88 percent of the population, while the option "degree" has been selected the most in the questionnaire.

According to the responses, most of the respondents are having moderate fire knowledge and aware about the fire safety measures that are being implemented in their daily life. However, they do not familiar with operating the fire extinguisher effectively. In the aspect of human factors, the respondents tend to leave everything behind for evacuation when they hear the fire alarm. Nonetheless, that will still be waiting for other peoples before escape. Moreover, the respondents hold the perspective saying that they will threat the fire drills and fire alarm seriously. Lastly, majority of the respondents knowledgeable about the fire hazards and its cause-and-effect relationship.

Based on the results of Pearson correlation testing, the correlation coefficient obtained for two variables, which are fire knowledge and fire hazards with its consequences have significant relationship. The correlation coefficient values are 0.645 and 0.399. Fire knowledge scored the highest value followed by the variable of fire hazards with its consequences. In contrast, the variable that obtained the lowest correlation coefficient value is 0.039, which is human factors in fire safety.

#### **CHAPTER 5**

#### CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Overview

This chapter integrates all research findings and some comparisons with the findings of the past studies that have been discussed throughout the report. In addition, the outcomes of the statistical analysis that has been conducted and discussed in Chapter 4, which are descriptive analysis and Pearson Correlation Coefficient will be discussed in this chapter as well. After all, the contents will move on to conclude the research questions and research objectives that has been mentioned in Chapter 1. This research study mainly focuses on whether the level of fire safety awareness has significantly influence by the given variables, such as fire knowledges, human factors in fire safety, and fire hazards with its consequences. Based on the outcome of this study, the fire knowledge and understanding of fire hazard with its consequences are dependent on the level of fire awareness of the occupants. In contrast, the results of human factors in fire safety in this study is slightly different as compared to the previous study done by (Subramaniam, 2004).

# 5.2 The effect of fire knowledge towards the level of fire safety awareness among the occupants in UTAR, Kampar Campus.

As indicated in previous chapter, fire knowledge has been analyzed by using Pearson correlation coefficient. Based on the result shown in this study, the fire knowledge will significantly influence the level of fire safety awareness of the occupants in UTAR, Kampar Campus. A previous study indicates that it is necessary to equip the individual with fire knowledge, so that the individual will have higher fire awareness and respond time can be reduced as many as possible (Huseyin and Satyen, 2006). Subsequently, another research that analyze the same variable as this study revealed that the nurse who frequently involve in fire safety training tends to have higher level of awareness as compared to others (Cho, Lee and Hwang, 2022). Therefore, fire knowledge should be taken into account in improving the fire awareness among the occupants.

However, the study that aims to evaluate the relationship between the fire knowledge and the level of fire safety awareness is limited. Most of the researchers conducted a cross-sectional study to determine the level of fire safety awareness and level of fire knowledge of the individual and analyze separately. For instance, the research done by Cho, Lee and Hwang (2022) to study the level of safety awareness, knowledge, and attitude of the nurses who either received frequent training programmes or in opposite. In fact, cross-sectional study is commonly performed to determine a common point between the given variables (Cherry, 2019).

# 5.3 The effect of human factors in fire safety towards the level of fire safety awareness among the occupants in UTAR, Kampar Campus.

Referring to the research framework shown in Chapter 2, human factors in fire safety is the second component to be evaluated in this research. According to the Pearson correlation analysis result shown in the previous chapter, it indicates that there is no significant relationship between human factors in fire safety with the level of fire safety awareness among the occupants in UTAR, Kampar Campus. The analysis of this variable is modified from the study about the relationship between human factors and fire safety measures which done by Subramaniam (2004). The researcher found that among three different factors, which are predisposing factors, reinforcing factors and enabling factors, only predisposing factors such as attitude will influence the fire safety (Subramaniam, 2004). Therefore, human factor or behaviour is selected as the variable for further study to determine whether the human factor or behaviour will influence the fire safety awareness of the individual. However, the results of this study does not paralleled with the result of the previous study. Hence, it is believed that this variable is not suitable to be applied in this study.

# 5.4 The effect of fire hazards with its consequences towards the level of fire safety awareness among the occupants in UTAR, Kampar Campus.

Fire hazards can result in various type of consequences, it is ranging from mild to severe. The analysis result of this study indicates that there is a significant relationship between fire hazards with its consequences towards the level of fire safety awareness among the occupants in UTAR, Kampar Campus. In 2019, Kodur, Kumar and Muhammad Masood Rafi pointed that the fire incident caused by malfunction of electrical appliances, negligence, and open flame relatively low as compared to cooking is due to the residents has higher level of fire safety awareness.

In addition, the past studies always link the fire hazards with the consciousness of the individual towards the fire safety. A great example raised in the previous study, the researcher revealed that the peoples are unaware of the fire hazards, causing the city become susceptible to the fire disaster (Islam and Hossain, 2018). To put it simply, better understanding of fire hazard and its consequences can greatly raising the level of fire safety awareness among the peoples. Therefore, the fire occurrence can be reduced effectively, and the safety as well as welfare of the peoples are secured.

#### 5.5 Limitations

This study will pay attention solely on discovering the relationship between fire level of fire safety awareness among the occupants in UTAR, Kampar campus and. 3 different variables including fire knowledge, human factors/ behaviors and fire hazards with its consequences. Additionally, the ratio of the sample obtained in this study is not balance. The responses from staff are relatively lower than the students. Such condition might somehow affect the research outcomes. Additionally, the level of understanding might be significantly different between students and staffs. Besides that, this study is mainly depending on the perspective of the occupants in UTAR, Kampar Campus. Also, the recommendations provided are based on the outcomes of the study. For that reason, the outcome of the study might not perfectly fit to apply in other similar institution. As mentioned earlier, this study will still present as a reference for other researchers.

#### **5.6 Recommendations**

#### 5.6.1 Recommendations for Future Study

There are several recommendations can be done for improvement and helpful for future study. First and foremost, the research method for this study can be done in qualitative approach to obtain more detail outputs from the respondents. Even though quantitative approach can provide a statistical and numerical proves that showing the relationship between the variables, however, this approach does not allow the researcher to obtain the information other than the questionnaires, such as asking for opinions. Therefore, qualitative approach is helpful in determining the most feasible and practical fire safety measures based on the opinions and considerations of the respondents.

Furthermore, the demographic of respondents can be narrowed down to focus on one specific group. For instance, the study is conducted to determine the fire safety awareness among the high-risk group such as lab staffs, student who performs lab work and etc. Apart from that, the target respondents for the future study can also focus on either students or staffs to ensure the quality of the results and prevent some other issue. For example, the issue of imbalance samples group like the ratio of students is greater than staffs.

Moreover, there are other possible variables can be included in the study to improve the comprehensiveness and coverage of the research. This is helpful for the researcher to ensure the improvements for the existing fire safety measures can cover broader issues which further reduce the fire outbreaks. Additionally, even though there is no significant correlation between the level of fire awareness and human factors or behaviours, however, this factor will affect the fire safety in real life. Hence, extra research is needed to determine the suitable items in determining how the human factors or behaviors influence the fire safety and awareness among the occupants. On the other hand, this study does not cover the evaluation of existing fire safety measures in UTAR, Kampar Campus. In fact, fire safety measures play significant roles in preventing and suppressing the fire, as well as protecting lives, environment, and property. Hence, the fire safety measures, and protective system must be reliable and well-maintained. In this case, the future study can include this section to evaluate the existing fire safety measures and propose the recommendations based on the findings.

#### **5.6.2 Recommendations to Improve Fire Safety in the Campus**

The priority of the improvement is determined based on the analysis results as illustrated in Chapter 4. Based on the results, fire knowledge and understanding of fire hazards with its consequences are having strong relationship with the level of fire safety awareness. This means that the level of fire safety awareness will increase by enhancing or strengthen the fire knowledge and understanding of fire hazard with its consequences of the occupants in UTAR, Kampar Campus.

First and foremost, the fire knowledge can be enhanced by providing sufficient fire education, such as training, fire safety campaign, fire drills, and etc. It is crucial for the management of the university to ensure the accessibility of the information related to fire safety. On the other hand, the occupants including students and staffs must equipped with the basic fire knowledge, such as notice the location of evacuation plan fire extinguisher, fire alarm, and exit door, understand the components that causing fire, and etc. Fire education should not only stress the theoretical knowledge, but also to practice their psychomotor skill. For instance, learning the correct way to operate fire extinguisher after briefing. This can ensure the individuals are capable to save themselves by putting off the fire before the scenario get worse. The fire safety campaign should be conducted in campus wide to allow the occupants to disseminate and share the fire knowledge with each other. The activities such as poster contest allows the occupants to elucidate the importance of fire knowledge. Besides that, the understanding of fire hazards and the consequence of the occupant is a must to prevent the fire occurrences. As mentioned earlier, fire hazard is a risk or leading cause of the fire incident. When the occupants notice that the fire hazard can bring numerous severe consequences, they tend to pay more attention and efforts in reducing the potential fire risk. Therefore, raising their awareness of fire safety. For instance, there are numerous fire hazards can be spotted in the laboratory, such as flammable liquid and oxidizing agents. When the lab users especially students and lab officer notice about the existence of these hazards, they will handle the substance with care or avoid using the flammable chemical nearby the potential ignition sources like sparks and flames. This objective can be achieved by displaying the fire hazards signages at the prominent area to warn the occupants regarding the combustible, flammable substances or other material that can cause fire and explosion. In addition, it is recommended to have a notice board to display the information regarding fire hazards, its impacts, facts about the fire and the correct way to deal with the fire and hazards.

In terms of fire safety management, the management of university should ensure the emergency response plan is accessible by the related person, especially emergency response team, and fire marshals. It is also a must to provide adequate training and retraining program to the staffs in emergency responding and the proper actions to be taken when dealing with fire or any other emergency situation, such as chemical spillage. Moreover, fire risk assessment should be conducted to inspect the potential fire hazards and the effectiveness of the existing control measures that are applied to minimize the possibility of fire occurrence.

#### 5.7 Summary

In brief, the data collected from the questionnaires are analyzed by using descriptive analysis and Pearson correlation coefficient. There are two variables which are fire knowledge and fire hazards with its consequences have significant correlation with the level of fire safety awareness of occupants in UTAR, Kampar Campus. The correlation coefficient values for fire knowledge and fire hazards with its consequences are 0.645 and 0.399. The significant value of these variables is below 0.01. In contrast, there was no significant correlation between human factors and the level of fire awareness of occupants. The correlation between human factors and the significant value is higher than 0.05, which indicates that there is no correlation between the variables.

Therefore, the objectives of this research study have been achieved which is to determine the level of fire safety knowledge of the occupants and the relationship between the fire knowledge, human factors/ behaviours, and fire hazards with its consequences with the level of fire safety awareness of the occupants in UTAR, Kampar Campus. The hypothesis of fire knowledge and fire hazards with its consequences are accepted, while the hypothesis of the variable regarding human factors/ behaviours is rejected due to there is no correlation between this variable with the level of fire safety awareness.

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APPENDICES

**Appendix 1: Questionnaires** 



## UNIVERSITI TUNKU ABDUL RAHMAN

## FACULTY OF ENGINEERING AND GREEN TECHNOLOGY

# BACHELOR OF SCIENCE (HONOURS) ENVIRONMENTAL, OCCUPATIONAL SAFETY AND HEALTH

### JUNE TRIMESTER 2022

**UGNB4916 PROJECT** 

NAME	SAMMI WONG JIA CHYI		
STUDENT ID	17AGB03246		

NAME OF SUPERVISOR: ChM. TS. CHIN KAH SENG

#### PERSONAL DATA PROTECTION NOTICE

Please be informed that in accordance with Personal Data Protection Act 2010 ("PDPA") which came into force on 15 November 2013, Universiti Tunku Abdul Rahman ("UTAR") is hereby bound to make notice and require consent in relation to collection, recording, storage, usage and retention of personal information.

- 1. Personal data refers to any information which may directly or indirectly identify a person which could include sensitive personal data and expression of opinion. Among others it includes:
  - a) Name
  - b) Identity card
  - c) Place of Birth
  - d) Address
  - e) Education History
  - f) Employment History
  - g) Medical History
  - h) Blood type
  - i) Race
  - j) Religion
  - k) Photo
  - 1) Personal Information and Associated Research Data
- 2. The purposes for which your personal data may be used are inclusive but not limited to:
  - a) For assessment of any application to UTAR
  - b) For processing any benefits and services
  - c) For communication purposes
  - d) For advertorial and news
  - e) For general administration and record purposes
  - f) For enhancing the value of education
  - g) For educational and related purposes consequential to UTAR
  - h) For replying any responds to complaints and enquiries
  - i) For the purpose of our corporate governance
  - j) For the purposes of conducting research/ collaboration
- 3. Your personal data may be transferred and/or disclosed to third party and/or UTAR collaborative partners including but not limited to the respective and appointed outsourcing agents for purpose of fulfilling our obligations to you in respect of the purposes and all such other purposes that are related to the purposes and also in providing integrated services, maintaining and storing records. Your data may be shared when required by laws and when disclosure is necessary to comply with applicable laws.

- 4. Any personal information retained by UTAR shall be destroyed and/or deleted in accordance with our retention policy applicable for us in the event such information is no longer required.
- 5. UTAR is committed in ensuring the confidentiality, protection, security and accuracy of your personal information made available to us and it has been our ongoing strict policy to ensure that your personal information is accurate, complete, not misleading and updated. UTAR would also ensure that your personal data shall not be used for political and commercial purposes.

#### Consent:

- 6. By submitting or providing your personal data to UTAR, you had consented and agreed for your personal data to be used in accordance to the terms and conditions in the Notice and our relevant policy .
- 7. If you do not consent or subsequently withdraw your consent to the processing and disclosure of your personal data, UTAR will not be able to fulfill our obligations or to contact you or to assist you in respect of the purposes and/or for any other purposes related to the purpose.
- 8. You may access and update your personal data by writing to me at sammiwongjc99@1utar.my

Dear respondent,

I am a final year undergraduate student of Bachelor of Science (Honours) Environmental, Occupational Safety and Health, Universiti Tunku Abdul Rahman (UTAR), Kampar Campus.

As part of my Final Year Project (FYP), I am conducting a survey amongst the occupants in UTAR, Kampar Campus. The focus of this research is on the fire safety & awareness among the occupants in this campus.

I would appreciate if you could spare a couple of minutes to fill a short anonymous questionnaire.

The collected data will be used only for research purposes and will be kept confidential. For your information, the responses would not be able to trace back to any individual participants.

This survey is designed for the occupants in UTAR, Kampar Campus. Your participation is completely voluntary.

If there are any doubts or issues with the content of the questionnaire, do contact me at sammiwongjc99@1utar.my. Thank you for your participation.

#### Acknowledgement of Notice

I have been notified and that I hereby understood, consented and agreed per UTAR above notice.

#### **Instructions:**

- 1. This questionnaire consists of **FIVE** (5) sections:
  - Section A: Demographic Information
  - Section B: Level of Fire Safety Awareness
  - Section C: Fire Safety Knowledge
  - Section D: Human Factors in Fire Safety
  - Section E: Fire Hazards with its Consequences

Please kindly answer ALL questions in ALL sections based on your own perspective.

For Section B to Section E, the questionnaires utilize the 5 Point Likert Scale as indicator. By using the scale below, you are required to indicate the extent of your agreement/disagreement with the statements in this questionnaire. Please <u>tick</u> ( ✓ ) at the appropriate box.

#### Scale:

Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
5	4	3	2	1

### **Section A: Demographic Information**

1. Gender

		Male		Female	
2.	Age				
		20 years old and below	V		21 – 25 years old
		26 – 30 years old			31 – 35 years old
		36 – 40 years old			41 years old and above

3.	Eth	nic					
		Malay				Indian	
		Chinese				Other:	
4.	Lev	el of Study					
		Foundation		Diploma		Degree	
		Master		PhD			
5.	Posi	ition					
		Student			U	TAR academic staff	
		UTAR administrativ	ve staf	ff			
6.	Fac	ulty / Institute / Cen	tre				
		Centre for Foundation (CFS)	on Stı	udies	Fa (F.	culty of Arts and Social Scie AS)	er
		Faculty of Busin	ness	and	Fa	culty of Engineering and G	re

Centre for Foundation Studies (CFS)	Faculty of Arts and Social Science (FAS)
Faculty of Business and Finance (FBF)	Faculty of Engineering and Green Technology (FEGT)
Faculty of Information and Communication Technology (FICT)	Faculty of Science (FSc)
Institute of Chinese Studies (ICS)	

## Section B: Level of Fire Safety Awareness

No.	Item Description	5	4	3	2	1
1.	I am aware of the danger of the fire occurrence.					
2.	I am aware of the nearest location of the fire extinguishers, fire break glass alarm or fire hose reels.					
3.	I am aware of the location where fire evacuation floorplan is available and the assembly area.					
4.	Fire safety is always my concern.					
5.	I know what to do in case of fire happens.					
6.	I am aware of the potential ignition points and sources of fire.					

## Section C: Fire Safety Knowledge

No.	Item Description	5	4	3	2	1
1.	I know how to operate a portable fire extinguisher effectively.					
2.	I understand the concept of fire triangle / fire tetrahedron.					
3.	I have participated in fire drills or any fire safety programme.					
4.	I know the purpose and function of the fire emergency response team and plan.					
5.	I am familiar with the stages of fire development.					
6.	I know that the type of fire extinguisher to be used is depending on the types / classes of fire.					
## Section D: Human Factors in Fire Safety

No.	Item Description	5	4	3	2	1
1.	If I hear the fire alarm, I will stop my work and escape immediately.					
2.	When the fire alarm is triggered, I will feel panic and find difficulty in escaping from the building / environment that I am not familiar with.					
3.	In case of a fire, I will wait for my colleagues / family / friends before fleeing from the building.					
4.	If I discover a fire, I will leave the building immediately without triggering the fire alarm.					
5.	When the fire alarm is triggered, I will simply assume it is a false alarm.					
6.	If I know that a fire drill is being conducted, I will not treat it seriously.					

## Section E: Fire Hazards with Its Consequences

No.	Item Description	5	4	3	2	1
1.	I know the purpose of conducting fire risk assessment.					
2.	I know that cigarette is one of the major causes of the fire that claimed numerous lives.					
3.	I understand fire hazards can increase the risk of fire occurrences and pose adverse impacts / casualties.					
4.	I know that overloading extension wires and sockets can increase the risk of fire occurrences and explosions.					
5.	I know that flammable / combustible substances should be kept away from the source of ignition (electrical, heating appliances).					
6.	I know that waste accumulation is one of the fire hazards that can results in rapid spread of fire.					

THE END. THANK YOU FOR YOUR PARTICIPATION.