Quality Awareness on Fire Safety Equipment for A Building. A Review Paper from The UAE Perspective

By

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Abstract

Fire safety reduces the risk of injury and building damage that fires can cause. Developing and implementing fire safety protocols in the workplace is not only required by law but it is crucial to everyone's safety that may be in the building during a fire emergency. The UAE is one of the most innovative countries in the Middle East with high quality infrastructure and fire safety system. Yet, it still suffers of several weaknesses and at the heart of them improving public awareness. In addition, there is a lack of consensus and empirical evidence with regard to the application of the quality awareness model in improving fire equipment safety awareness and measures. Therefore, this review paper aims to suggest a quality awareness model that improves fire safety equipment for a building. The finding of this paper generates knowledge that can be useful for building owners and occupants in the UAE that can serve as a guiding framework for the development of fire safety measures in developing countries.

**Keyword:** *Quality, Awareness, Safety, Building, UAE*

Introduction

The UAE is a federation of seven emirates located in the Middle East region. Currently, the country is moving towards urbanization, modernization and smart city development. As such, the government has been investing heavily in development projects including the development of high-rise buildings and luxury real estate developments. Due to the geographical location of UAE, the country has become susceptible to fire incidents. For example, fire deaths and injuries in Dubai were reported to accumulate to a total number of 112 and 361 respectively between 2006 and 2013 (Alqassim and Daeid, 2014). This suggests that fire safety has become one of the most critical issues growing in UAE particularly in relation to building damage.

Number of fire incidents in Dubai, UAE, from 1/1/2006 to 31/12/2013.

Type of event	2006	2007	2008	2009	2010	2011	2012	2013	Total	%
Motor vehicles	268	269	295	243	255	238	235	266	2069	37.7
Residential units	174	224	249	177	142	170	223	190	1549	28.2
Commercial stores	94	60	87	75	89	63	80	94	642	11.7
Industrial plants/storage places	50	60	83	53	57	43	47	35	428	7.8
Construction sites	15	31	44	28	14	17	14	8	171	3.1
Electrical sign boards	19	11	23	24	19	19	21	16	152	2.8
Government establishments	8	5	5	7	18	9	10	11	73	1.3
Ships and boats	6	9	6	11	9	12	8	6	67	1.2
Used tyres and solid waste	6	7	6	5	1	10	12	5	52	0.9
Self-immolation	2	7	6	10	7	1	8	4	45	0.8
Others	29	39	34	27	39	36	24	14	242	4.4
Total	671	722	838	660	650	618	682	649	5490	100.0

Figure 1: *Number of Fire Incidents in Dubai, UAE, 2006 – 2013 (Alqassim and Daeid, 2014)*

As shown in figure 1, a number of fire related incidents have been reported in UAE which means that fire safety is important in the country. In particular, building fires in UAE are apparent due to the increase in high-rise buildings in the country. Yu-Ting and Zhou (2016) asserted that fire safety situations in UAE has been viewed as a priority because of their significant impacts on the society as a whole. Consequently, fire outbreaks in buildings and facilities present risks to humans and their properties (Kikwasi, 2015). Fire at a 25-storey building (Al Baker Tower 4) in Al Taawun area resulted to the displacement of 125 families (Gulf News, 2017) show the negligence and lack of awareness on fire safety. Although Dubai is known with the excellent performance for fire prevention (Yu-Ting and Zhou, 2016), the number of fire-related incidents in Dubai from 2006 to 2013 has reached 5490 (Figure 1.3) (Alqassim and Daeid, 2014).
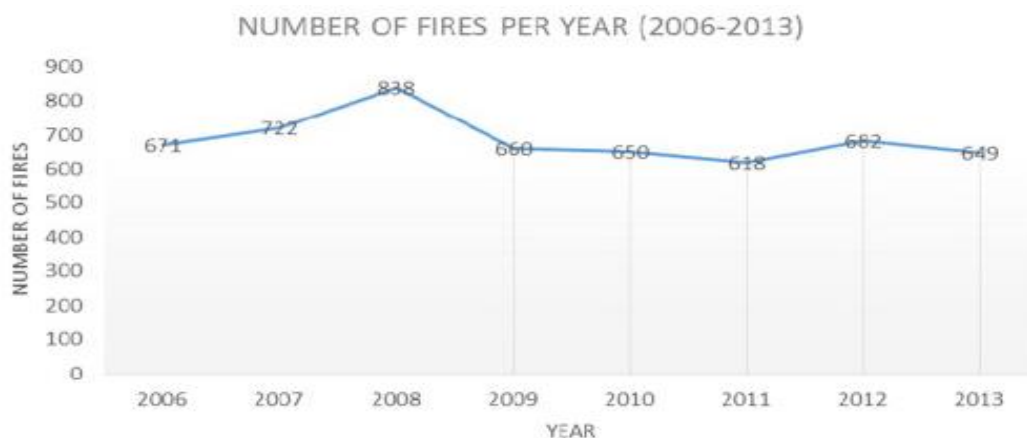
Figure 1: *Number of Fires Per Year in Dubai, 2006 – 2013 (Alqassim and Daeid, 2014)*

Fires take place without any warning and can originate from various sources. When fire breaks out, building occupants are restricted in the amount of time they have to put out the fire (Agyekum, et al, 2016). Thus, the importance of fire safety preparedness and management has become a growing interest in risk management planning. According to Alqassim and Daeid (2014), a typical fire development occurs over four consecutive stages including incipient, growth, fully developed and decay. As such, understanding these development stages can aid in the implementation of fire preventive measures and investment in appropriate fire safety equipment. In the contemporary era, one of the most effective fire safety equipment in buildings include fire protection system and fire alarms. Figure 3 shows the typical design of fire alarm and firefighting system.
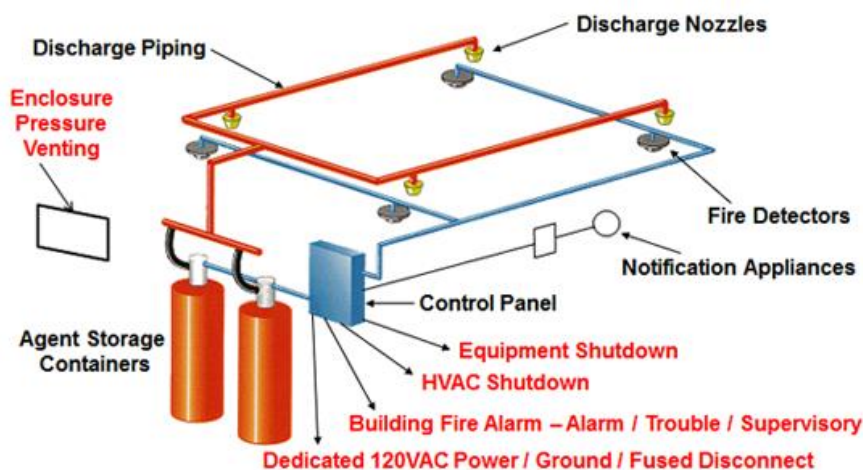
Figure 2: *Fire Protection System (ADT UAE, 2017)*

Kikwasi (2015) disclosed that 60% of building users do not know how to operate the facilities and 41% are not aware of available escape means in case of fire outbreak. Hayward [12] disclosed that, in one study, respondents were presented with six different signs and everyone understood the "NO SMOKING" sign and "EMERGENCY EXIT" with a man running sign but only 53% understood the sign for fire hose and concluded that only half of the population understands such signs. A study by Makushita [8] revealed that all residents living in high-rise buildings of Anand City are not aware about Emergency Operation Centre and majority are not aware whether their buildings are constructed according to the National Building Code and fire safety. There are a number of factors such as increasing number of buildings, defect as an issue on old buildings and uncertainties that can result to building defects (i.e. natural calamities, terrorist attacks, etc.) that contribute to the high risk of probability in terms of the occurrence of defects (Bakrim & Mydin, 2014). As defined by Kraus, et al (2017), defect refers to poor construction resulting from inappropriate design and inadequate execution of the project thereby leading to decreased performance of the structures. The high quality of the fire safety equipment in building is often being neglected. The use of fake cable or extension cords of fire equipment leads to massive fire in Sharjah's industrial area (Ramahi, 2017); (Afkar, 2019). With the advanced technology, most of fire sensor network are currently used wired automatic fire alarm system (Shu-guang, 2011). He added that mostly cables are easily to be eroded, bitten by rats, frayed, causing to high fault rate and high false alarm rate. This is also confirmed by (Yang et al., 2020) that shows that fire in buses in China is caused by the drivers' wrong operations and the passengers' dangerous actions on the bus. It shows that drivers and passengers lacking knowledge on the safety procedure and emergencies conduct.

2. The UAE construction

The last few decades have witnessed rapid growth of UAE's economy construction and lasting expansion of city building density. The high-rise buildings constructions become more and more, objectively it puts forward more severe challenge to urban fire protection. Fire safety in buildings shall be provided in accordance with the provisions recommended by the building codes of practice. While, the development of high-rise building, in particular, have improved the safety dramatically through the use of modern fire safety equipment. For example, the design of Burj Khalifa is equipped with programmed elevators to permit speed evacuation for fire or security events (Szolomicki, 2019). The application of the quality awareness model on fire equipment for safety of buildings is taken into consideration. According to Muindi (2014), creating awareness among employees on fire equipment safety can increase the level of fire safety preparedness as well as knowledge on the proper use of fire equipment should fire should break out on buildings. In line with this, Ghufli (2012) noted that the initiatives based on TQM principles can be implemented towards promoting quality awareness and readiness among the people. More so, Kikwasi (2015) asserted that fire safety measures include fire extinguisher, fire detection and alarm system and fire safety awareness and preparedness. This suggests that the application of the quality awareness model can be seen as an effective process of reducing fire outbreaks on buildings.

Even though fire regulation, codes and standard have been develop in many countries, still there are a number of fire accidents in a year (Brushlinsky et al., 2016). One of the main attributes of this anomaly is the variation in the level of compliance efficiency, the degree to which fire safety provisions are implemented, the fire safety regulations in the specified building codes and standards of each country (Kodur, Kumar and Rafi, 2019). This is very important from the point of view of fire safety, as the level of fire safety prescribed in codes

and standards will not matter if they are not properly followed and implemented in buildings. This is major challenge for many developing countries due to lack of enforcing mechanism/awareness, resources and poor regulating environments (Shinggu, Kadala and Joseph, 2020); (Kodur, Kumar and Rafi, 2019).

Negligence and lack of awareness are considered as major causes of fires. Cooking, heating, electrical malfunction, open flame and arson are the most cause of fire in residential and non-residential in USA. This represent the decreasing number of human awareness about the effect of fire hazards on life, property and environment safety. Similarly, Ramahi (2017) identified other potential causes of fires to include lack of maintenance, human errors, non-compliance with fire safety measures in buildings and culture of poor fire safety awareness among others. Therefore, Ramahi noted that greater awareness on fire safety equipment and measures can help reduce fires in buildings.

3 The Challenges of Fire Safety in the UAE Construction Industry

The UAE has multiple regulations governing different aspects of construction and fire safety, with no single overarching document. There is also a clear differentiation between building and fire safety regulations, with different regulatory bodies. Concerns relate to a lack of clarity, inconsistencies and confusion over which codes and standards apply in which circumstances (UK Fire Safety: Interim Report). Further, many existing buildings may not comply with fire national codes that address fire safety for life and property protection (Alqassim and Daeid, 2014).

As advances have improved the safety of building, however the safety of building and its tenants is uncertain in the case of a fire. Whether codes of practice or modern fire safety equipment that are built and designed to protect property and human life, the dominant contributor to fire incidents is the human behaviour factor (Sulaiman, Rashid and Mahyuddin, 2012). More variables need to be studied to further understanding between human and fire safety relationship. This is evident by their suggestion for further studies, recommending more human behaviour factors to be investigated as antecedents of awareness behaviour and leads to prevent the fire at early stage (Subramaniam, 2004; Yang et al., 2020). Moreover, human behaviour for fire safety prevention is a rapidly developing field yet there are limited quality reports on the human awareness on quality of fire safety in buildings especially in UAE.

4 Opportunities for Improving Fire Safety in the UAE Construction Industry

Awareness is highly related to the belief of humans. Thus, the current study uses the framework of the Theory of Theory of Planned Behavior (TPB). TPB has strong predictive utility for a wide range of human behaviors (Ajzen & Madden, 1986). By modifying TPB, the theory is frequently used to provide a better understanding of individuals' decision-making process in various contexts. Although extensive research have already been made to facilitate the fire safety management (Zakaria et al., 2019; Yang et al., 2020; Herno Della, Lirn and Shang, 2020). To the best of author knowledge, is a large scarcity of studies of study on the awareness of quality of fire equipment.

Awareness has been associated to human behaviour and decision-making process or response in a fire events (Kuligowski, 2008). In the TPB behavior could be predicted from an immediate antecedent of the intention to perform the behavior. In the same way, intention can

be determined by its antecedents of behaviour, subjective norm and perceived behavior control on quality awareness of fire equipment. Combined, attitude and subjective norm form intention which in turn, shapes behavior (Mishra, & Mishra, 2014), Due to its adaptation and mitigation, TPB and various extended forms have been proposed to explore the purchase intention for green products (Zhang et al., 2019); green hotel visit intention (Liat et al., 2019); selection of sustainable restaurant (Tommasetti et al., 2018), shopping behaviour (Londono, Davies and Elms, 2017) and sensation-seeking tourism place (Meng and Han, 2018). Nevertheless, few studies investigated the use of TPB to examine how quality awareness of safety officers in a building about fire equipment quality issues would affect their quality awareness behaviour (Flores and Sun, 2018); (Yang et al., 2020). Quality awareness becomes essential for fire equipment installation to obtain full advantage fire safety protection. Previous studies are dominated by fire engineering capacity (Sufianto, Nugroho and Aditama, 2017; Walls et al., 2020; Yang et al., 2020; Taher, Vahdatikhaki and Hammad, 2019; Çakiroğlu and Gökoğlu, 2019). In addition, previous studies measure the fire safety performance using safety consciousness (Khan, Ahmad and Ilyas, 2018; Prussia, Willis and Rao, 2019; Meng and Chan, 2020). Structural equation modeling (SEM) has been widely used in the psychology and behavioral sciences. Therein, covariance-based SEMs and variance-based/component-based SEMs are two prevalent methods. This study adopted a component-based SEM that uses a least squares estimation procedure due to its high suitability for smaller sample sizes.

In line with the efforts to improve the quality awareness and minimise the fire accidents in building. However, the objective is elusive without a sound understanding of how quality awareness impact safety officers knowledge and consciousness to carry out the quality fire equipment installation practice (Flores and Sun, 2018). Few of the previous studies deploy direct relation. An examination of Safety officers' knowledge and consciousness within the TPB framework as independent variables would provide a better understanding of fire safety equipment decision-making process, which further contributes a theoretical development and provides fire prevention strategies as a segment variable which helps in developing effective preventive strategies.

4.1 Quality Awareness

The importance of quality is primarily evident on its critical role in any business organization. For one, quality is a factor that contributes largely to an organization's competitive advantage and needs continuous improvement. However, quality can either be referring to the product or the service. In terms of product quality, there are three primary dimensions taken into account, according to Buntak, et al (2012). These include: (1) product functionality; (2) product reliability and durability; and (3) constituting a hedonistic addition to the product. On the other hand, service quality is defined as "the customer's impression of the relative superiority/inferiority of a service provider and its services and is often considered similar to the customer's overall attitude towards the company" (Prakash & Mohanty, 2012). Despite the different perceptions of quality in relevance to service or product, its context remains the same, that is, being linked to standards and requirements set by the customers. Quality in fire management is crucial as there is significant risk to life, property and environmental safety. Failure in following the fire equipment code and standard may creates threats to life, property and environmental safety. Thus, it is important for fire safety managers creates the quality awareness to prevent any accidents in a building.

In the study of Elshaer (2012), various definitions of quality are cited. One of these definitions entails that quality resembles excellence; however, such can be invalid because of standards of excellence can vary with lack of criteria in measuring quality. Another definition, as mentioned by Elshaer (2012), was from Garvin (1984) which denoted that quality is a

product-based approach. It is also noted that quality is basically conformance to specification and standards. However, all these conditions are summed up by Juran (1951), entailing that quality is "fitness for use", with the word "use" being related to customer requirements and "fitness" being relevant to conformance to measurable characteristics of product or service. Furthermore, Elshaer (2012) underpins this simple definition of quality awareness which states that: "Quality awareness is a situation when a set of inherent characteristics consistently fulfil the continuously changing requirements of the organization's customers and other stakeholders." Similarly, Kashif et al. (2006) quality awareness is the shared vision of quality system. It starts with creating knowledge environment in the organization through training on basic quality knowledge.

In relation to understanding quality awareness, it is also consequently important to explore the concept of quality management. As indicated by Chukwulozie, et al (2018), quality management is an approach that allows organizations to achieve and sustain quality. It is composed of different generic practices which include top management commitment and support, organization for quality, employee training, employee participation, and supplier quality management, among others. All these aspects are essential in not only having a deeper understanding about quality per se; but, they also help organizations effectively implement quality standards to ensure satisfaction of customers. More so, in the context of quality awareness which is discussed in the next section of this chapter, quality management is a directly linked concept. One of the reasons for failure of quality of fire safety in buildings is proven to be the behaviour of human. The key aspect of managing quality awareness is the involvement of people in the quality process and empower them to participate actively (Kashif et el. 2006). The fire safety management often has to deal with the awareness (unawareness) of human to comply with installation of equipment that follow fire safety code and standard. As shown in Figure 4, many fire safety equipment are poorly managed and maintained, leading to poor quality performance of fire safety of mall building. To address this issue, this study aims to design a new awareness model for improving the quality of safety fire safety management and maintenance.
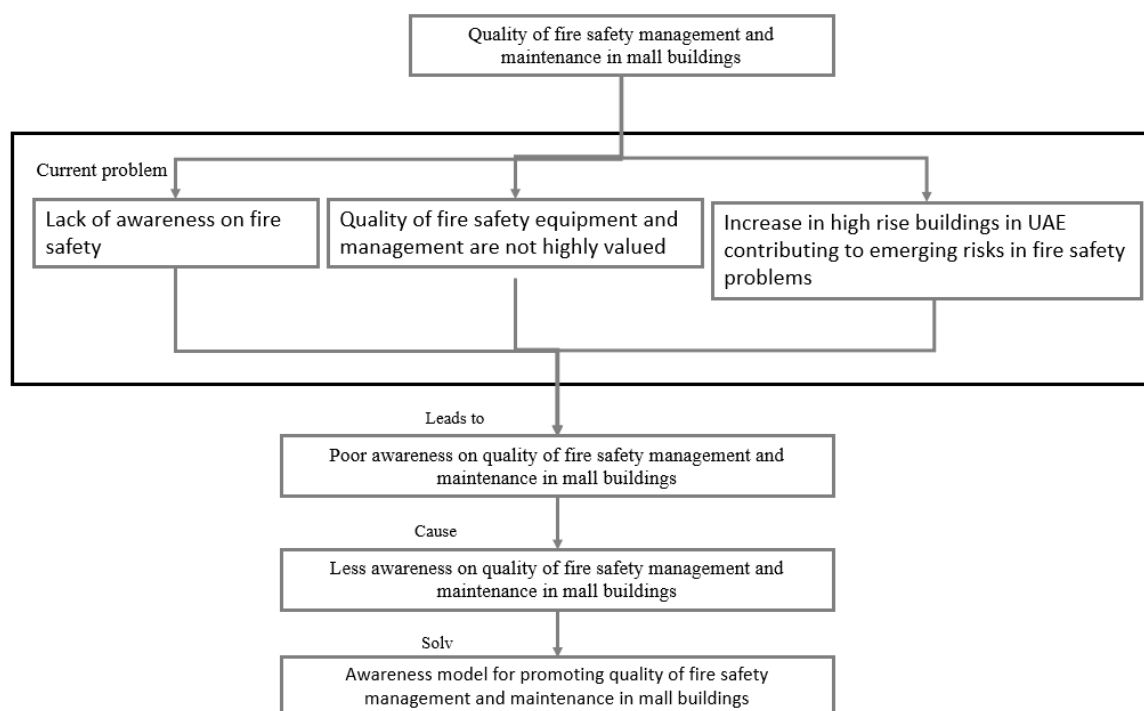
Figure 4: *Theoretical Framework*

5. Conclusion

Awareness and the ability to utilize available fire safety provisions definitely protect people and their properties due to fire occurrence (Kikwasi, 2015). Awareness levels of essential stakeholders can be low when assessed (Rahim, Taib & Mydine, 2014). Such poor awareness level can be reflected on how some building users are unaware, unknowledgeable and incapable of operating fire prevention facilities and even available escape areas in case of fire outbreaks (Kachenje, Kihila & Nguluma, 2010). Common themes suggest that employee involvement and quality training are among the antecedents that influence quality awareness behaviors contributing to the promotion of quality practices (Mabesh, et al, 2010; Sadikoglu and Olcay, 2014). In addition, it is also important to note that product/service quality, quality policy and quality management must be incorporated in corporate culture in order to influence quality awareness amongst employees (Kahsay, et al, 2007). This suggests that influencing quality awareness encompasses focus on training, policies, standards and involvement towards achieving increased safety awareness and effective fire safety management that can influence good quality practices within firms (Ebenehi, et al, 2018).

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