The management of building fire safety towards the sustainability of Malaysian public universities

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Abstract. Recently, there had been reduction in annual budgetary allocations to public universities in Malaysia due to some economic tensions. This situation had left many institutions in question with the options of scaling down their expenses as well as sourcing for other means of meeting up with the shortfalls in allocated funds. Hence, it affects the sustainability of the building itself. This paper is an attempt to look at the possibility of reducing incidents that could lead to expending unbudgeted fund to rehabilitating property unfortunately destroyed by fire on campus, in addition to limiting risk to life and interruption of academic and business activities. Several research had been conducted on FSM, nevertheless very few consider Higher Education Institutions (HEI)s holistically. Hence this research intends to fill that gap.

1. Introduction
Buildings are among the most important investments for any Higher Educational Institution (HEI) which serve as meeting point for students, teachers and the communities [1]. Malaysian government and private organisations made huge investments running into billions of Ringgits in constructing these structures and the facilities within them. This is evident from the number of HEIs including Universities and Colleges that are publicly and privately funded [2]. For instance, located in Malaysia are over 500 tertiary institutions comprising 20 public universities, over 70 private universities, 33 polytechnics, 72 community colleges, 27 teachers' education institutes and about 403 active colleges [2, 3]. HEIs provide students and the entire institutions' community with an environment that is attractive, conducive to learning and academic success [4]. It is therefore important to adequately protect buildings from fire destruction, as well as the life of the users through appropriate FSM implementation [1]. Fire safety management (FSM) encompasses the combination of or coordination of some activities or programs to avert destruction from fire [1]. Such programs include escape routes provisions and maintenance, fire prevention measures, staff training, and fire drill training, etc. [5] described FSM as "the application by a manager of policy, standards, tools, information and practices to the task of analysing, evaluating and controlling fire safety". Pickard [6] asserted that fire safety strategy for a specific building requires management policies and procedures for the strategy to function effectively. Fire safety strategy should be a continuing process such that fire safety systems

are regularly checked and maintained. Normally, fire takes place without warning allowing building occupants limited time to react either to extinguish the fire or to escape [7]. Effective FSM requires identifying all the potential risk associated with the premises and effectively carrying out an assessment of the adequacy of the measures provided or needed to resist the risk [8]. In addition, the concept of sustainable development was firmly embedded within the environmental movement, but still has social and economy values in sustainable use of natural resources. This implies that sustainability is a wide area covering topics from economy to social and the issues relating to ecological sustainability. While all business enterprises can make contributions towards its sustainability attainment, the ability to make a difference varies by sector and organisation size where the role of business in contributing to sustainable development remains unlimited [9, 10]. In view of that, sustainable development is good business in itself. It creates opportunities for suppliers of 'green consumers', developers of environmentally safer materials and processes. Hence, firms that invest in 'green' are eco-efficiency and engage themselves in social well-being.

2. Background of study
Furthermore, FSM is concerned with lessening the potential of harm to life and damage to properties resulting from the occurrence of fire in buildings [11, 12]. The importance of FSM in relation to modern large or complex buildings, has been identified for several years, though, the challenges are yet to be completely addressed. The growing complexity of buildings as well the fire safety systems' sophistication place more responsibility on management than has been traditionally essential [13]. Protecting buildings from fire can be tackled from two perspectives. Namely Building design, and Building operation /management [14]. Although, fire safety priority is very low during the building design process, it is generally included to satisfy minimum requirements for building regulations and recommendation of the insurance company [15]. Therefore, if an efficient management team is put in place to operate a property, such property would be safe from fire even if poorly designed. However, a well-designed building that is not operated by efficient management team may likely have issues with fire safety during the building lifecycle. Many of the major disasters including fires which happened in recent decades were characterised by a failure of management, whether before or during those incidences. Example was the 1987 fire at King's Cross underground station, London. Consequently, great emphasis has been placed on the importance of management in safety as well as focusing on both corporate and individual liability in this respect [13]. Apart from that, sustainable development is a process of change in which exploitation of resources, the direction of investments, the orientation of technological developments and institutional are all in harmony and enhance current and future potential to meet human needs and aspirations. It is reflected on many Governments around the world when they take on sustainable development on the agenda for the development project [16, 17]. Organisations around the world that incorporate sustainable practices to strengthen their organisation goals can increase shareholders' values and build better global market share.

3. Problem statement
Campus Firewatch [18] stated that no fewer than 146 people perished in campus fire in the United states between 2000 and 2011. These comprised of both on-campus and off-campus fire incidences. Several injuries were sustained and property loss worth $9 million were reported [19]. The impact of fire fatality on HEIs campuses could be very serious due to the homogenous nature of students' population with respect to age and experience [20]. Furthermore, substantial fire loads such as books, papers, and other document in lecturer's offices in High education institutions (HEI)s could contribute significantly to fire severity [21].

Research had shown that a number of fire incidence happen in tertiary institutions' buildings [22]. The cost of the incidents to the HEIs from both financial and public image perspectives could be substantial [23]. These incidents take place especially among students in hostels while they are attending classes or during siesta [4]. Numerous fire incidents mainly of small scale occur in campuses without being reported. Report from the United States Fire Administration (USFA) indicated that an

average 1700 fires were recorded annually in the United States of America (USA) [20]. The abovementioned figure increased by over 100% in the USFA's report between 2007 and 2009 as 3,800 fires were recounted in university houses in 2009. The campus fires usually occur during the months of September and October when schools are starting fresh academic session which lead to estimated fatalities of five people annually [19].

In the United Kingdom, two campus fire incidents were recorded in 2001 [25, 26]. The first one occurred in the main campus of the City University London and destroyed College Building on 25 of May. Result of the fire investigation revealed that the fire started from an office of a member of staff. The affected building was grade II listed building accommodating five academic departments, the school of journalism and computing as well as the vice-chancellor's office. The second incident took place on November 2, 2001. The fire attacked a 100 years old Bower Building at the Glasgow University, Scotland destroying PhD work of ten Botany students. It took two years to carryout restoration work on the destroyed building at the cost GBP 6.5 pound and GBP 3.5 million for the equipment. The building was opened for use in 2005 [26, 27]. Furthermore, on September 12, 2014, the GlaxoSmithKline Carbon Neutral Laboratory for Sustainable Chemistry at the Nottingham University, UK was destroyed by fire attributed to electrical fault. The GBP 20 million structure which was at advanced stage of completion was completely razed down [28, 29]. Other examples of fire incident in HEIs include a clubhouse fire at Nelson Mandela Metropolitan University South Africa in October, 2016, the University of Jos Nigeria Library fire on October 10, 2016, the hostel fire at International Islamic university of Malaysia (IIUM), 2014, Dewan Tunku Canselor (DTC), of Universiti Malaya (UM) among others [29–32]. The need for HEIs to protect students, employees, and physical facilities cannot be overstated. This is because if a disastrous loss ensues, media coverage may affect the institutions' reputation, posing a risk to future admissions, financial strengths, and endowments [21].

Report from the Fire and Rescue Department of Malaysia (FRDM) indicated a steady increase in fire incidents from 2000 to 2015 [7, 33, 34]. For instance, in 2006 FRDM attended to 18,913 fire calls, and 20,225 in 2007. Fire occurrences in 2012 was 29,848 which was 11% higher than the relatively stable statistics from 2009 to 2012. From 2013 to 2015, fire incidents recorded were 33,640 for 2013, 54,517 for 2014 and 80,183 for 2015 [7, 34]. Abdul Rahim [34] also conveyed that fire related death doubled between 2011 to 2012 that is, from 72 deaths in 2011 to 152 in 2012 and then to 165 in 2013. The cost implication of damages from fire in 2013 is about 20 billion Malaysia Ringgit (MYR 20 billion), which was an increase of MYR 874.31 million from 2012 [35, 36]. The main causes of fire include arson, cooking, smoking, electrical sources, and other unknown sources, to this Abdul Rahim [34] called for more investigative efforts to obtain useful information for developing precautionary strategies in Malaysia.

No doubt enormous investments made in the education especially in the higher education sector is in line with fulfilling a set target of creating an attractive environment, conducive for learning and academic excellence [4]. It is therefore duty bound on all stakeholders to zealously guard various infrastructure from fire destruction. In accordance with building world class higher education institutions, Malaysian government spent more on education compared to other sectors, for instance [37] reported that about 27% of the National budget was spent on education. Such gesture allows for training of human resources that shall tackle future challenges in various sectors of economy [38]. However, in recent time, the fund allocation to public universities is dwindling due to some challenging economic situation [39, 40]. Therefore, necessitating paying great attention to protecting buildings from all form of disasters including fire.

4. Discussion
Substantial effort had also been made at internationalizing Malaysian higher education with a resultant saving of about RM4 billion annually. RM2.5billion is the amount that could be saved if Malaysian students decide not to study abroad and take advantage of provisions made in Malaysian universities and other higher educations, whereas RM1.5 billion in net revenue realised from over 50000 students

from various countries [38]. Malaysia had also set the target of becoming by 2020, the world's sixth-biggest education exporting country, and therefore making plans to accommodating about 200,000 international students [41]. This projection doubled the aspiration in the 9th Malaysia plan for attracting 100,000 students from overseas by 2010 [38]. In view of these strides, research relating to the managing fire safety in Malaysian higher education's buildings becomes imperative especially as no building have total immunity against fire occurrences [34, 44]. Previous research concerning management of fire safety in buildings had dealt with other types of building/structure such as karaoke establishment [43], oil and gas [44], non-residential high rise buildings [45, 46], residential high rise buildings [43], nursing homes [44], hotel buildings [45], heritage buildings [7], passenger terminals [50] airport terminals [51], enclosed shopping centres [52], cruise vessel construction [53] and hospital [50]. However, few of these studies had specifically looked at tertiary education buildings holistically. Though, Kong [21] studied possible implementation of performance-based design for fire safety provisions in higher education institutes, no emphasis was placed on fire safety management strategies adoption. In addition, there are research covering students' housing [4, 12, 55, 56], and other publications dealing with cafeteria [57] and library [58, 59]. This research seeks to investigate the implementation of fire safety management implementation strategies in Malaysian Higher Educational Institutions (HEI) with a view to developing a framework for effective fire safety management for all building types and occupancies in the institutions.

Statistical surveys in different parts of the world established that fires occur regularly in buildings with costly consequences [12, 60]. In the United Kingdom (UK), the direct cost of fire was estimated as 8 billion GBP in 2003. In addition, the health and safety commission (HSC) approximated the annual cost of health and safety failure as 18billion GBP [61]. The United States Fire Administration reported that about 118 deaths related to campus fire had been witnessed from year 2000 to 2015 in the United States of America (USA). 80% of those incidents occurred in off-campus housing due to the following factors [62]:

- Careless disposal of smoking materials.
- Missing or disabled smoke alarms.
- Lack of automatic fire sprinklers.
- Alcohol consumption.

According to the guidance jointly produced by [8], the obligation of an organisation's management to fire safety is essential to achieving suitable fire safety standards in buildings and in upholding staff's culture with respect to fire safety. Dublin Fire Brigade [63] consider FSM as a key factor which must be present to forestall fire disaster in buildings such as large shopping malls. According to the Dublin Fire Brigade [63] and the British Standards Institution [64] FSM structure should make provisions for the following:

- Clear lines of responsibility, authority, accountability, and resources.
- Replacements of absentees with specific responsibilities.
- An emergency services liaison officers to call for supplying information to the fire and rescue services.

FSM encompasses the whole lifecycle of the building and include the following constituents [63]:

- Day to day operation of the building.
- Changes of building.
- Change of use.
- Unit in disuse.

Similarly, Tsui and Chow [65] outlined the objectives of FSM components to include maintenance of fire safety measures and fire prevention, staff training, emergency action plan, and assessment on

building alternative. FSM programmes consist of inspection, education and training, fire suppression, emergency service, evaluation of fire probability, fire prevention, report and record keeping, as well as communication [66, 67]. The following benefit can be accomplished when and effective FSM is developed and implemented [67]:

- Reduction of property insurance premiums.
- Continuity of business operation.
- Enhancement of public images and customer service.
- Promote an efficient work environment.
- Quality gain realization.
- Influence an organisation profitability.

For the above stated benefits to be realised, the fire safety managers should up to his responsibilities as stated by the Dublin fire brigade, thus:

- Awareness of fire safety features and their functions.
- To monitor general maintenance and building/refurbishment work.
- To maintain register of fire certificates and compliance for all buildings/ refurbishment works.
- Fire safety risk assessment.
- To be present at the commencement of building occupation.
- To liaise with fire authority and seek advice.

The person appointed as a fire safety manager is responsible for total control and daily building safety management. The appointed fire safety manager should be practically knowledgeable to direct firefighters to affected areas in buildings during emergency especially in complex buildings [67]. Hence, Fire safety practices and awareness is very necessary as adequate knowledge of fire, cause, prevention, suppression and the provision of adequate firefighting equipment are important to be available and handled adequately by the appointed person in any building.

5. Conclusion
This research seeks to investigate the implementation of fire safety management strategies in Malaysian Higher Educational Institutions (HEI) with a view to have sustainability aspects. The work creates a space for research in to detail understanding of fire safety management practices, and current implementation strategies of FSM principles among Malaysian universities. Therefore, a framework for effective fire safety management for all building types and occupancies in the institutions shall be developed and validated on completion of the research.

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