

# **Evacuation drill: A test of emergency preparedness**

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## **Abstract:**

Considerable research efforts abound on safety issues during construction phase of built facilities, but very low attention is paid to safety during operation phase; instead security occupies top priority. Responding to factors such as technological and increase in student's population, many higher institutions globally are expanding their built facilities in terms of quantity, size and sophistication. There are many situations that infringe on the safety of the end-users; they include fire, natural and man-made disasters. The simplest approach to test the emergency preparedness of the end-user of the facilities as well as the adequacies of critical components of the built facilities is to simulate emergency through evacuation drill. Conducting evacuation drill in Higher Education institution is complex due to the composition of its constituency, multiple activities, time constraints and the human dynamics: some view evacuation drill as a wasteful exercise. The case study method of qualitative research is adopted; the data are collected through semi-structured questionnaire complemented with interview, observation and participation. The findings include evidence of the display of safety awareness documents, sensitization lectures and running mini evacuation drills in the different segment of the institution. Although the response rate to evacuation drill is low at the moment, with more commitments and advocacy it is possible to progress towards benchmarking the exercise with regulatory standards.

**Keywords:** Building, Evacuation drill, Emergency, Higher education institution, Safety

## **1. INTRODUCTION**

The built facilities in many Higher Education (HE) institutions have been in existence for many decades and have traversed through different legislative years with changing requirements. However, the development of physical facilities, in HE institutions, is an ongoing exercise that has increased in number, size and sophistications, in order to keep pace with technological advances and accommodate increase in programmes and events in the institutions. Whether in the old or new built facilities, there are many situations that infringe on the safety of the end-users;

they include, but not limited to, fire, natural and man-made disasters. Therefore, implementing safety requirements poses considerable challenge in some of the old as well as new facilities. During the operation phase, the need for safety and security presents two compelling scenario that demands equal attention. Safety focuses on the protection of customers and employees from injury or death while security focuses on the safeguard of life, possession and property (Rittichainuwat and Chakraborty, 2012). Therefore, safety awareness, preparation and mitigation of emergency situation should be given due consideration in all HE institutions.

In the case studied for this research, three independent, yet inter-related divisions of the Facilities Management (FM) unit of the institution perform the functions of Security, Occupational Health and Occupational Safety. This paper reports on the operation of the occupational safety division only, as they seek to create awareness on issues that infringe on the safety, with the sole objective of protecting the end-users as well as the built facility of the institution. The structure of the paper commence with literature review to locate the topic within its context, the research method, findings and discussion before drawing conclusion and recommendations. For ethical reasons, the institution and respondents will be referred to in generic terms.

## **2. LITERATURE REVIEW**

The issue of safety in the operation of built facility has continued to attract considerable research activities. This section will provide synthesis of literature focusing on fire incidence, exit facilities and the place of evacuation drill in evaluating the emergency preparedness of both the operators and users of built facilities.

### **2.1 Fire Incidence**

There are many factors responsible for fire incidence within built facilities. In HE institutions, they include faulty electrical connections, appliances and overloading electrical circuit. Other causes are due to error in the handling of inflammable materials, design and construction related mistakes as well as operational negligence. There are two broad regulatory provisions to guide facility design and operators against fire hazards in the form of 'prescriptive' and 'performance-based' codes (Tavares, 2009); emphases is shifting to the use of the performance-based code in the design and operation of facilities (Croce *et al.*, 2008; Tavares, 2009; Chixiang *et al.*, 2012). In the prescriptive codes, sets of measures are prescribed to reach the fire safety in buildings without concrete steps on how to develop the measures or ensure them. The performance-based code provides guidelines on the level of expected performance of the main components in the form of fire, enclosure and occupants and "their interactions: fire-enclosure, fire-occupants; occupants-enclosure and occupant-occupants: (Tavares, 2009, p. 752)". This information

provides clear guidance to the facilities designers and FM operator on the quality and quantity of smoke detector, fire alarm systems, the exit facilities, safe travel distance and consideration of the end-users, with particular reference to people with physical challenges (Hassanain, 2008; Tavares, 2009).

In a typical HE institution, changes in academic programme, expansion of existing ones and changes in teaching methodologies require alteration, modification or expansion of existing built facilities. In order to make these changes easier, modern design of academic facilities adopts the concept of ‘flexible structure’, where the envelope and major elements are made of solid structural components and the partitions or in-filling panels are made of lightweight materials. The materials used in the majority of these in-filling panels are highly combustible, thus increasing the risk of fire incidence within built facilities (Hassanain, 2008). Therefore, consideration of the safety of the end-users within built facilities, during emergency, is important. In this regard, considerations should be given to the safe travelling distance, the quantity and functionality of the exit facilities.

## **2.2 Exit Facilities**

The architecture of many buildings in HE institutions is complex to end-users, especially for visitors and occasional users of the facility. Salient but critical factors that should be addressed in all facilities include obstructions on exit routes, proper signage at close proximity along the exit route and functional exit facilities (Liu *et al.*, 2011).

Obstructions on the exit routes include turning the space into informal storage of broken furniture, converting the space into tea room, photo copying purposes, storage of cleaning materials, or a formal office space. Though some of these actions are borne out of necessity, yet the safety implications are grave in the event of emergency. Under normal circumstances, way finding within complex facility is daunting and more so during emergency (Kobes *et al.*, 2010a; Liu *et al.*, 2011). As a consequence, the confusion unnecessarily stresses people who make use of the building. Liu *et al.* (2011: 364) observes, “Although the signs may be present in a building, the occupants may not understand them and find the way out”. It is imperative for the facility operators to provide adequate and legible signs to guide end-users to the nearest exit, using more than one language, and consistent colour to indicate the directional signs and exit features (Notake *et al.*, 2001; Liu *et al.*, 2011). To underscore the importance of functional exit facility, Tavares (2009) cited an ugly incidence that occurred during a film shooting of TV show for children; “the studio was... of combustible materials, such as polythene, polymers, polyvinyl chloride, etc. and *the emergency exit was locked*” [*emphasis mine*] (Tavares, 2009, p.751).

Another dimension introduced to the issue of safe exit from a building during emergency includes the use of the building for multiple functions. Many academic buildings, either as stand-alone or within a complex, provides accommodation for different interest groups as offices, lecture facilities,

laboratories, libraries, commercials, restaurants and underground parking. To accommodate all these interests, the majority of the buildings are high rise in nature (Osman and Ram, 2013). During emergency, the recommended route for escape for occupants and access for rescue workers is through the stairway. The main access stairways are usually wide enough to accommodate more than one person walking side by side, but the emergency stairways are not that wide. It may be necessary to assign the main access stairway for the evacuation of occupants while the emergency stairway is used by the rescue operators. In this regard, during evacuation drill, “the assigned optimal routes are communicated to individual...and officials are to impose the schedules in execution” (Osman and Ram, 2013, p.234).

Beside the constraints of facilities lay out, functional services and exit facilities, the human dynamics constitute a major concern in the effective management of safe evacuation during emergencies. These human dynamics should be tested through evacuation drill.

### **2.3 Evacuation Drill**

In many developed countries, there are statutory regulations mandating operators of built facilities to carry out periodic evacuation drill. For example, in the New Zealand, safety regulation requires that evacuation drill should be conducted in facilities where “more than 100 people gather and buildings used to store hazardous materials” (Ko *et al.*, 2007, p.91). Evacuation drill is intended to simulate, as closely as possible, the situations that end-users of the built facility would face if fire were located in a remote area of the facility where the only indication of the fire would be the sound of the fire alarm (Ko *et al.*, 2007). Some of the common fire alarm systems and evacuation route guide include siren type evacuation alarm, emergency lighting, illuminated exits signs and pre-recorded evacuation directives hoisted on a ‘public address’ (PA) system (Olsson and Regan, 2001). If the occupants of the built facility are to respond appropriately to the fire alarm, it presupposes that they should be introduced to the sounds and signals, by way of orientation, lectures, and information through the intranet.

During evacuation drill or emergency situation, the occupants’ response are influenced by different factors that include the configuration of the enclosure or architectural lay out, environmental factors inside the structure, procedures implemented within the enclosure and most important of all, behaviour of the occupants (Ko *et al.*, 2007; Woodcock and Au 2013). Li-min and Guo-qing (2013) discovered that customers or visitors’ first response on hearing about fire is to reach out to the escape facility, while the staff will first want to confirm the fire, try to put it out or call for help from the Police or fire fighter before heading for the escape route, if the fire is out of control. Furthermore, the duo revealed that adult men will be the last to seek escape compared to women, the elderly and children (Li-min and Guo-qing, 2013). This may provide a clue as to why in HE institutions some male (staff and students) are reluctant to participate in evacuation drills. An attitude that should be discouraged is the re-entry into the building during the evacuation

exercise. Research has shown that great fatalities have occurred in real fire situations due to the re-entry of occupants in search of family members or loved ones (Ko *et al.*, 2007; Kobes *et al.*, 2010b).

Literature strongly support the use of evacuation drills as a guide that enables facility operator to evaluate the functional levels of the essential safety infrastructure, the quality of human components available to help during emergency, the cooperation of occupants and above all the safe exit times from the respective built facility. However, at the awareness phase aimed at developing safety consciousness, the evacuation exercise could be planned ahead, but latter, the exercise should be conducted with very little or no prior notice, in order to be able to determine the egress time and benchmark it against statutory standards; this is the approach being experimented in the research report for this paper.

### **3.0 RESEARCH METHODOLOGY**

The qualitative method for case study research was adopted; the research data were collected through semi-structured questionnaire complemented with interview, observation and participation. The case study method allows for in-depth and accurate information about a particular situation or phenomenon within its context and allows the researcher to relate with the actors directly involved in the subject matter being investigated (Green and Thorogood, 2009; Lateef *et al.*, 2010). The academic sample for the research was drawn from the level of the deans and the heads of department. Their information was corroborated with the information obtained from the staff of occupational safety division. The validity and authenticity of the research information were ascertained through 'member checks' where the researcher recycles the analysis back to the key informants for confirmation of reported speech; and 'thick description' which involves detailed description of the context in which the enquiry took place (Amaratunga *et al.*, 2002). There are evidence of safety information hoisted at different locations in the campuses of the institution, however, response to evacuation drill is gathering momentum; this will facilitate benchmarking the exercise with regulatory standards.

### **4.0 FINDINGS AND DISCUSSIONS**

The occupational safety division is the division of FM unit that deals with the safety issues in the institution. The occupational safety policy of the institution under reference states that:

The University... is committed to safety excellence and will conduct business with respect and care in order to ensure an environment that is safe and without risk to its employees and other persons who may be affected by its activities

Some key objectives of this policy include:

- a. Provide guidelines to address safety with a view to minimizing risk by recognition, evaluation, control and continuous improvement in order to provide and maintain a healthy and safe work environment;
- b. Provide, educate, train and develop its employees and stakeholders in terms of Occupational Safety;
- c. Develop, implement and maintain effective emergency procedure

In this regard, the Occupational Safety division has developed fourteen key elements around which to implement the safety policy; six of these elements will be referred to in this paper, namely safety meetings, safety training, safety audits, safety awareness, fire prevention and protection (De Bruyn, 2012). The division liaises with each department to appoint safety representatives that are trained to identify breach of safety, carry out basic preventative measures, provides first aid in the event of emergency, report incidence or emergency to the appropriate persons. The audit is a monthly exercise that encompasses the inspection of all safety alarm features; appropriate report is registered against any of the features that are not functioning properly. Another general item on the audit exercise is the inspection of exit route, to ensure that they are free, and that the emergency exit doors are functional. Progressively, safety awareness information is displayed clearly at different points and places in the campus; especially where there is anticipated reduction in the velocity of pedestrian movements, in order to attract their attention, so that they may stop and read. Some of these locations are the ascent and descent from stairway, notice board, entrance to or behind the door of public toilets.

Further to these static notices, safety awareness are equally carried out through organized lectures and orientation for new staff members as well as safety tips posted on the intranet from time to time. In order to test the emergency preparedness of definite departments (where the basic infrastructure are in place), fire evacuation drills are conducted from time to time; observations from each exercise provides the road map for improvements.

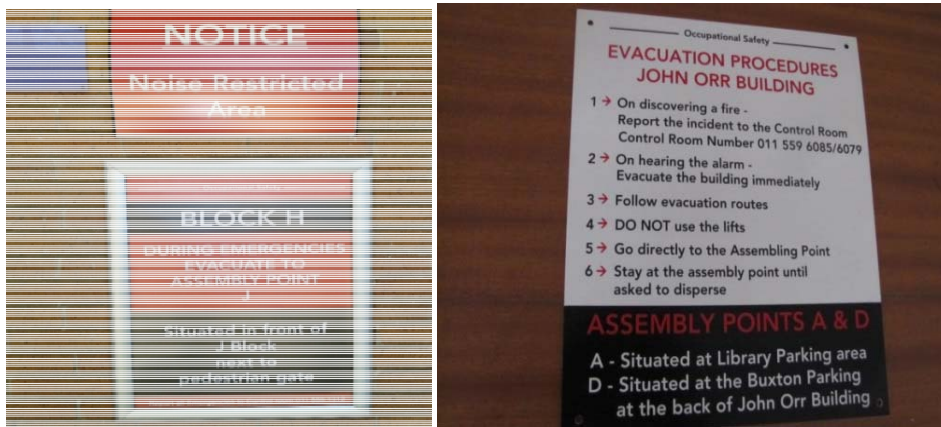


Figure 1 Information on evacuation procedure at different location (Photographs taking at different places in the campus)

#### 4.1 Response to Safety Matters

The level of awareness and response to safety matters by the academics was evaluated from their response to appropriate questions during the interviews. As shown in Tables 1&2, the majority of the academics interviewed are not aware of the basic information on safety and the operations of the Occupational safety division. The majority claim that they have not been informed about evacuation exercise, and have not had any training session or practical test of the functionality of the exit route nor on managing emergency situation. Research on safety within built facilities have stressed the need for consistent information flow, maintain functional egress route, main exit and emergency exit facilities in order to reduce fatality rates (Notake *et al.*, 2001, Liu *et al.*, 2001, Tavares, 2009). Also important are adequate and legible signs to guide end-users to the nearest exit; preferably use more than one language that is common to the majority of the end-users, adopt consistent colour to indicate the directional signs and exit features (Notake *et al.*, 2001; Liu *et al.*, 2001).

Table 1: Safety information and operations

Location	Academics response		
	Qty.	Yes	No
Academics participation in safety matters	25	8	17

<b>Training in safety</b>	<b>25</b>	<b>9</b>	<b>16</b>
<b>Functional exit facilities</b>	<b>25</b>	<b>8</b>	<b>17</b>

Furthermore, Table2 shows the number of academics that have witnessed or participated in evacuation drill in their department. The major reasons include that they have not seen any occupational safety staff to tell them what to do; as they cannot differentiate between normal evacuation alarms from testing or when such alarm system is faulty, and the ‘I don’t care’ attitude (of staff and students) towards evacuation drill. Members of the university community should be educated to know that evacuation drills are not mere theatrical rehearsals but safety precautions aimed at preparing users of built facility to know how to respond in the event of any emergency. Countries, such as, New Zealand have made evacuation drill mandatory for facilities where “more than 100 people gather and buildings used to store hazardous materials” (Ko *et al.*, 2007, p.91).

Table 2: Evacuation drill witnessed

<b>Location</b>	<b>Academics response</b>		
	<b>Qty.</b>	<b>Yes</b>	<b>No</b>
<b>Library</b>	<b>25</b>	<b>5</b>	<b>20</b>
<b>Laboratory</b>	<b>25</b>	<b>3</b>	<b>22</b>
<b>Lecture hall</b>	<b>25</b>	<b>3</b>	<b>22</b>
<b>Offices</b>	<b>25</b>	<b>5</b>	<b>20</b>

FM operators should devote extra attention to managing safety issues within built facilities that has complex architecture, so that routing and way finding be easier for end-user and visitors. Research shows that, the architectural flow of the constructed facility, spatial connections and layouts turn out to be confusing and induces unnecessarily stresses on the people who make use of the building (Kobes *et al.*, 2010b; Osman and Ram, 2013). Though evacuation exercise are easier to conduct in ‘stand-alone’ facilities compared to the complex facilities, the level of participation from the academics, as observed during this research, is still at its rudimentary level. During typical evacuation drill, some staff and students have requested for



permission to enter the building to collect their valuables, but the security personnel on duty have been very firm in refusing to grant such requests; with this simple question, “if there was real fire, and you were able to escape at first, will you want to go in again to recover your valuables?”. There are research evidences and real life experiences confirming that great fatalities have occurred in real fire situations due to the re-entry of occupants in search of family members or loved ones (Ko *et al.*, 2007; Kobes *et al.*, 2010b; Woodcock and Au, 2013). As part of effective emergency preparedness, occupants should be educated on the need to secure their personal safety first before properties; the properties can be replaced, but not the human life.

#### **4.2 Benchmarking**

Benchmarking has been described as a continuous search for the application of significantly better practices that leads to superior competitive performance (Varcoe, 1996) and involves identifying a point of reference (a benchmark) which serves as a standard against which relative performance may be judged. The point of reference may be internal to an organization or external in relation to competitors or ‘best practice’ (Loosemore and Hsin, 2001). The occupational safety division, in this institution, is using the response rate in every evacuation drill as internal benchmark to measure the effectiveness of the safety awareness campaign. Between April and July 2014, three pre-announced evacuation drills were conducted in standalone properties, in the order shown in Table 3. The response time was measured by the difference in time between when the first person vacated the building when the evacuation alarm sounded and the time it took the last person to leave the building and the end of the alarm

Table 3. Evacuation drill response rate

Property	Start alarm	End alarm	Time (min)	Participants
Faculty building housing lecture/seminar rooms, library, workshops, and offices	12.00	12.15	15	200
School of hotel & Tourism housing lecture/demonstration rooms, restaurant, kitchen and offices	13.57	14.03	6	65

Engineering building housing lecture halls, laboratories, workshop and offices	12.00	12.05	5	200
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Though the occupant capacity of each of the three properties, in Table 3 are in thousands, because the evacuation exercise were announced earlier and conducted during the off peak periods, the majority of the occupants were absent. Nevertheless, the response time showed remarkable improvements. Further improvements in the internal benchmarking will encourage the adoption of external benchmarking with statutory requirements (Loosemore and Hsin, 2001).

## 5.0 CONCLUSION AND RECOMMENDATION

The situations that infringe on the safety of end-users of built facilities in HE institutions are within the component parts of the built facilities, its operation and the actions of the occupants. The architecture of many edifice in HE institutions are increasingly becoming complex and impair on the end-users' ability to find their way within the facilities easily. In some instances, the designed capacity have been exceeded many times resulting in inadequate quantity and size of exit facilities. Therefore, implementing safety requirements poses considerable challenge. During the operation of built facilities, the simplest approach to test the emergency preparedness of the end-user of the facilities as well as the adequacies of critical components of the built facilities is to simulate emergency through evacuation drill. The results from typical evacuation drills enable the facility operator to evaluate the functional levels of the essential safety infrastructure, the quality of human components available to help during emergency, the cooperation of occupants and above all the safe exit times from the respective built facility. These are essential factors that allow the operators to develop effective mitigation plans. The findings from this research revealed that though safety awareness information are being communicated to the members of the university community, the level of understanding and participation in safety matters, especially evacuation drill is low. However, the progression in the response rate during evacuation drill is encouraging; further improvements are needed before it can benchmark the exercise against standard regulatory requirements.

Therefore, it is recommended that, the Occupational safety division should experiment with different communication methods in order to develop more intimate relationship with the heads of the department, win their support and cooperation. This will facilitate improved safety awareness and elicit their participation in exercises aimed at preparing their staff and students on how to identify and mitigate the negative effects of emergency situations (Notake *et al.*, 2001, Liu *et al.*, 2001, Tavares, 2009).

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