Assessing the Effectiveness of Fire Safety Management from the FSM Stakeholders' Perspective: A Pilot Study

Ibrahim Yakubu Ebenehi[1,2*], Sulzakimin Mohamed[1], Norliana Sarpin[1], Adejoh Ahmodu Adaji[1,3], Roshartini Omar[1], Seow Ta Wee[1]

[1]Department of Construction Management, Faculty of Technology Management & Business, Universiti Tun Hussein Onn Malaysia,
 Parit Raja, Batu Pahat, Johor, 86400, MALAYSIA

[2]Department of Building Technology, the Federal Polytechnic Bauchi,
Gwallameji Village, Off Dass Road, Bauchi-Tafawa Balewa, Bauchi, PMB 0231, NIGERIA

[3]Department of Building Technology, Kogi State Polytechnic Lokoja,
Lokoja, PMB 1101, NIGERIA

*Corresponding Author

Abstract: Malaysian education sector of the economy, particularly the higher education, had been making huge investments towards fulfilling a target of producing an attractive environment, conducive to learning and academic excellence. Building facilities account for a significant portion of investments in the sector. It has become imperative to research ways of ensuring the safety of built facilities and users from fire disaster since no building has immunity against fire. This research aims to develop a framework for effective fire safety management (FSM) for buildings in Malaysian Higher Education Institutions. This report displays the results of the pilot study conducted among staff from the facilities management, occupational safety health and environment (OSHE) and security departments from selected universities in Johor Malaysia prior to carrying out the core survey to collect information from target respondents. The pilot study shall help to minimise errors in the questionnaire, ensures the smooth running of the survey, facilitate the response rate, and provide a useful and valuable inquiry. The results include the descriptive statistics, reliability test, content and construct validity, the normality test, and factorability. The summary of the reliability test for each construct of the FSM Stakeholders' questionnaire, are Management and maintenance, 0.962; fire safety equipment/system, 0.921; building components safety design, 0.965, and the effectiveness of fire safety management have a value 0.916 for Cronbach alpha coefficient. The aggregate Descriptive Statistics results for the stakeholders' questionnaire show mean values between the ranges of 3.08 to 4.07. The questionnaire had low dispersion and standard deviation values of less than 1. The values of skewness and kurtosis were all within the recommended limit of -/+2, which indicates the normal distribution of all the constructs of the study. The results are a positive indicator to use the instrument for the primary survey.

Keywords: Buildings, Effective Fire Safety Management, Malaysia, Pilot Study, FSM Stakeholders

1. Introduction

Fire Safety Management (FSM) denotes the implementation of policy, standards, tools, information, and practices in an organisation directed towards analysis, evaluation, and control, of fire safety (Howarth and Kara- Zaitri, 1999). It is a continuous process of maintaining fire safety to reduce the number of fire incidents, the risk to lives and property to an extremely low and acceptable level (Hassanain, 2009; Billington, Copping, and Ferguson, 2002; Ramachandran, 1999). According to the Society of Fire Protection Engineers, SFPE (2005), FSM is a process of deciding the type of activities needed on the identification of fire hazards, exposure of populations, and prediction of foreseeable risks.

FSM roles are vital in the prevention and control of fires, the building occupants' evacuation, as well as the maintenance of safety systems. Also, as part of management procedures, the involvement of an independent auditor is necessary to regularly carry out fire protection audit at least two times a year (British Standards Institution, 1999; Chow, 2001). Yueng (2007) asserted that a properly managed building reduced the chances of fire outbreak and increased the possibility of successful occupants' evacuation in the event of an emergency.

Pilot testing of questionnaire survey is a crucial aspect in research design because; it helps to get the wordings of the questionnaire correctly and to increase the reliability, validity, and practicability of the survey (Cohen, Manion, and Morrison, 2013). It involves primarily the administration of the questionnaire to several respondents who are a representative of the target research sample and the subsequent use of statistical analysis and feedback to reduce the number of items in the questionnaire into a manageable number. Cohen et al., (2009) highlighted that the pilot data obtained from the pilot test is analysed to determine the following:
- Reliability
- Collinearity
- Multiple regression
- Factor analysis

This research aims to develop an effective fire safety management framework for building facilities in Malaysian Higher Education Institutions (HEIs). The following research objectives were formulated to achieve the stated aim:
1. To investigate current practices in fire safety management for university buildings in Malaysia
2. To determine critical factors contributing to the effective management of fire safety for university buildings in Malaysia
3. To examine the users/occupants' perception on, awareness of, and attitude toward, fire safety in Malaysian Higher Education Institutions (HEIs) buildings
4. To determine the relationship between users/occupants' perception on, awareness of, and attitude toward, fire safety and effectiveness of fire safety management in Malaysian (HEIs) buildings
5. To develop and validate a framework for effective management of fire safety for university buildings in Malaysia.

2. Pilot Study

Prior to conducting the main survey among respondents by collecting information to achieve the stated objectives, we carried out a pilot study. The purpose of the pilot study was to ensure the reliability and validity of the developed research instrument to minimise errors in the questionnaire, makes survey runs smoothly, facilitate response rate, and provide a useful and valuable inquiry (Muijs, 2004; Fink, 2006). Mathers, Fox, and Hunn (2007) pointed out that pilot-testing of questionnaire ensures the inclusion of all relevant issues; the correctness of its order; identification of ambiguous or misleading statements, and make sure there is no omission of any critical matter from the questionnaire. Pilot study improves the quality and structure of a survey (Creswell, 2013; Lodico et al. 2006). Collins and Hussey (2003) suggest testing a questionnaire through a pilot study irrespective of how best is its perceived design. The pilot sample comprises of participants selected at random and are given the survey to complete and requested to examine the study from different perspectives such as basic spelling and grammar, clarity of language and terms, breadth and depth of sub-questions and items, as well as overall psychometric properties of the instrument (Lodico et al. 2006).

The instrument was pilot tested on the sub-sample of the study sample. The collected data from the pilot study was analysed using the descriptive of the variables. The reliability was assessed using Cronbach's Alpha coefficient based on the recommendation of (Pallant, 2011). We evaluated the normality of the data using Skewness and Kurtosis based on the submission of George and Mallery (2010) that the values of Skewness and Kurtosis should be within the range of -/+2 for the response to be considered normally distributed. Similarly, the missing values and outliers were observed and treated accordingly. The structure of the data was also assessed using factor analysis. The possibility of multicollinearity was examined using the Variance Inflation Factor (VIF) and Tolerance level which is required to be less than 10 and 1 respectively (Pallant, 2011). This report is based on questionnaires for FSM Stakeholders of the HEIs buildings administered to the respondents of selected universities within Johor, Malaysia. Section 3 presents the result of the analysis.

3. Pilot Instrument Administrations

Table 1 shows the number of questionnaires administered to the respondents. We distributed a total of 60 questionnaires to FSM Stakeholders in Malaysian HEIs of which 91.7 percent were returned. However, of the returned questionnaire two were discarded due to issues of outliers and missing entries leaving 88.3 percent valid response for the analysis, which shows good response rate.

Table 1 - Pilot Instrument administration

Number of:	FSM Stakeholders	
	Frequency	Percent
Questionnaires Administered	60	100
Returned	55	91.7
Valid and Usable	53	88.3

Table 1 shows the distribution of questionnaires; the numbers returned and considered valid for analysis.

4. Data Descriptive, Normality, Reliability and Factorability

4.1 Stakeholder of Fire Safety Management in Malaysian HEIs

This section provides the result of the pilot study descriptive, normality, reliability and factorability according to the constructs in the FSM stakeholders' questionnaire. These constructs are Management and maintenance, fire safety equipment/system, building components safety design, and the effectiveness of fire safety management.

4.2 Management and Maintenance

Table 2 - Pilot Result for Management and Maintenance

Code	Mean	Normality		Factor	Variance	Cronbach
		Skewness	Kurtosis	Loadings	Explained	Alpha
Mgt_2.1	3.17	-.247	1.265	.664	61.20	0.962
Mgt_2.2	3.15	-.207	1.437	.622		
Mgt_2.3	3.19	-.617	1.928	.821		
Mgt_2.4	3.11	-.217	.750	.824		
Mgt_2.5	3.11	-.474	1.454	.877		
Mgt_2.6	2.92	-.047	-.213	.789		
Mgt_2.7	2.77	-.331	-.356	.750		
Mgt_2.8	3.11	-.586	2.058	.823		
Mgt_2.9	3.15	-.233	.958	.639		
Mgt_2.10	2.96	-.841	2.170	.813		
Mgt_2.11	3.13	-.870	1.662	.923		
Mgt_2.12	3.21	-.635	.941	.732		
Mgt_2.13	3.23	-1.007	1.743	.796		

Code	Mean	Skewness	Kurtosis	Loadings
Mgt_2.14	3.17	-.617	1.479	.832
Mgt_2.15	2.96	-.484	1.371	.707
Mgt_2.16	3.02	-.294	.920	.775
Mgt_2.17	3.04	-.669	.842	.842

Table 2 shows the pilot result for the Management and Maintenance construct which produces mean values ranging from 2.77 to 3.23. The values of skewness and kurtosis were all the threshold of -/+2 (George & Mallery, 2010) except for Mgt_2.8 and Mgt_2.10 which have kurtosis value above 2. All the variables under the construct have strong factor loadings which cumulatively explained 61.20 percent of the variance which is considered satisfactory. The reliability of the construct was assessed using Cronbach's alpha coefficient which produced a value of 0.962 above the recommended minimum threshold of 0.7 (Tabachnick & Fidel, 2007; George & Mallery, 2010; Pallant, 2011).

This result indicated that the result obtained is adequate; the data is normally distributed and reliable. Hence, the instrument is considered valid for the major survey of the research except for Mgt_2.8 and Mgt_2.10 which require further amendment.

4.3   Fire Safety equipment/System

Table 3 - Pilot Result for Fire Safety equipment/System

Code	Mean	Normality		Factor	Variance	Cronbach
		Skewness	Kurtosis	Loadings	Explained	Alpha
					73.706	**0.921**
Adq_FSS_3.1	3.53	.031	-.300	.909	**41.604**	**0.922**
Adq_FSS_3.2	3.42	-.459	.586	.910		
Adq_FSS_3.3	3.32	-.145	.035	.963		
Adq_FSS_3.4	3.32	-.069	-.197	.895		
Adq_FSS_3.5	3.32	-.382	.277	.804		
Adq_FSS_3.6	3.40	.080	.048	.767		
Adq_FSS_3.7	2.64	-.236	-1.126	**		
					12.175	**0.928**
Cond_FSS_4.1	3.66	-.140	-.042	.583		
Cond_FSS_4.2	3.55	-.456	-.149	.688		
Cond_FSS_4.3	3.53	-.710	.005	.744		
Cond_FSS_4.4	3.40	-.436	-.454	.809		
Cond_FSS_4.5	3.45	-.405	1.311	.831		
Cond_FSS_4.6	3.49	-.535	1.382	.845		
Cond_FSS_4.7	2.94	-.752	-.340	.841		

Code	Mean	Skewness	Kurtosis	Factor Loadings	Variance Explained	Cronbach Alpha
					19.175	**0.946**
Imp_FSS_5.1	4.17	-.273	-1.033	-.804		
Imp_FSS_5.2	4.06	-.092	-1.154	-.929		
Imp_FSS_5.3	4.08	-.118	-1.071	-.856		
Imp_FSS_5.4	4.06	-.512	-.438	-.922		
Imp_FSS_5.5	4.17	-1.021	1.315	-.886		
Imp_FSS_5.6	4.17	-1.021	1.315	-.875		
Imp_FSS_5.7	3.79	-.409	-.016	-.613		

Table 3 shows the pilot result for the Fire Safety Equipment/System construct, which has sub-constructs of the adequacy of fire safety equipment, the condition of fire safety equipment and importance attached to fire safety equipment by the management; which produces mean values ranging from 2.64 to 3.4.17. The values of skewness and kurtosis were all the threshold of -/+2 (George & Mallery, 2010). All the variables under the construct have strong factor loadings which cumulatively explained 73.706 percent of the variance in which 41.04, 12.175 and 19.175 percent were accounted by the adequacy of fire safety equipment, the condition of fire safety equipment and importance attached to fire safety equipment respectively, which are considered satisfactory. The reliability of the construct was assessed using Cronbach's alpha coefficient which produced an overall value of 0.921 with adequacy of fire safety equipment, condition of fire safety equipment and importance attached to fire safety equipment have values of 0.922, 0.928, and 0.946 respectively above the recommended minimum threshold of 0.7 (Tabachnick & Fidel, 2007; George & Mallery, 2010; Pallant, 2011).

This result indicated that the result obtained is adequate; the data is normally distributed and reliable. Hence, the instrument is considered valid for the main survey of the research.

4.4   Building Components Safety Design

Table 4 - Pilot Result of Building Components Safety Design

Code	Mean	Normality		Factor	Variance	Cronbach
		Skewness	Kurtosis	Loadings	Explained	Alpha
					71.617	**0.965**
Adq_PFSS_6.1	3.74	-.045	-.385	.904	**54.652**	**0.932**
Adq_PFSS_6.2	3.72	-.067	-.268	.868		
Adq_PFSS_6.3	3.79	.332	-.968	.732		
Adq_PFSS_6.4	3.72	-.067	-.268	.812		
Adq_PFSS_6.5	3.79	-.150	-.327	.641		
Adq_PFSS_6.6	3.62	-.080	-.416	.566		
Adq_PFSS_6.7	3.60	-.341	.685	.402		
Adq_PFSS_6.8	3.57	-.415	.636	.572		

Adq_PFSS_6.9	3.55	-.426	.417	.642	
					11.895	0.956
Cond_PFSS_7.1	3.68	.193	-.414	.564	
Cond_PFSS_7.2	3.70	.134	-.370	.561	
Cond_PFSS_7.3	3.66	.155	-.313	.582	
Cond_PFSS_7.4	3.68	.092	-.265	.590	
Cond_PFSS_7.5	3.62	-.091	-.076	.663	
Cond_PFSS_7.6	3.53	-.105	-.114	.651	
Cond_PFSS_7.7	3.53	-.686	1.603	.915	
Cond_PFSS_7.8	3.58	-.880	1.913	.870	
Cond_PFSS_7.9	3.47	-1.079	2.000	.638	
					5.070	0.954
Imp_PFSS_8.1	4.06	-.061	-.633	-.887	
Imp_PFSS_8.2	4.04	-.473	1.043	-.911	
Imp_PFSS_8.3	3.94	-.351	.559	-.830	
Imp_PFSS_8.4	3.92	-.300	.331	-.885	
Imp_PFSS_8.5	3.98	-.004	.252	-.812	
Imp_PFSS_8.6	3.94	-.289	.174	-.706	
Imp_PFSS_8.7	3.98	-.388	.634	-.703	
Imp_PFSS_8.8	3.98	-.388	.634	-.674	
Imp_PFSS_8.9	3.92	-.873	2.432	-.469	

Table 4 shows the pilot result for the Building Components Safety Design construct, which has sub-constructs of the adequacy of Building Components Safety Design, the condition of Building Components Safety Design and importance attached to Building Components Safety Design by the management; which produces mean values ranging from 3.47 to 4.06. The values of skewness and kurtosis were all within the threshold of -/+2 (George & Mallery, 2010) except for Imp_PFSS_8.9 which have a kurtosis value above 2. All the variables under the construct have strong factor loadings which cumulatively explained 71.617 percent of the variance in which 54.652, 11.895 and 5.070 percent were accounted by the adequacy of Building Components Safety Design, the condition of Building Components Safety Design and importance attached to Building Components Safety Design by the management respectively. The percentage of variance explained is considered satisfactory. The reliability of the construct was assessed using Cronbach's alpha coefficient which produced an overall value of 0.965 with adequacy of fire safety equipment, condition of fire safety equipment and importance attached to fire safety equipment have values of 0.932, 0.956, and 0.954 respectively above the recommended minimum threshold of 0.7 (Tabachnick & Fidel, 2007; George & Mallery, 2010; Pallant, 2011).

This result indicated that the result obtained is adequate; the data is normally distributed and reliable. Hence, the instrument is considered valid for the main survey of the research except for Imp_PFSS_8.9 which requires further amendment.

4.5 Effectiveness of Fire Safety Management

Table 5 - Pilot Result for Effectiveness of Fire Safety Management

Code	Mean	Normality		Factor Loadings	Variance Explained	Cronbach Alpha
		Skewness	Kurtosis			
EFSM2_9.1	2.45	.037	-1.022	.406	**58.47**	**0.916**
EFSM2_9.2	2.58	-.249	-.272	.453		
EFSM2_9.3	3.25	-.969	2.245	.863		
EFSM2_9.4	3.32	-.893	1.513	.856		
EFSM2_9.5	3.32	-.639	1.765	.832		
EFSM2_9.6	3.30	-1.168	2.143	.819		
EFSM2_9.7	3.17	-.819	.626	.925		
EFSM2_9.8	3.36	-.094	-.231	.624		
EFSM2_9.9	3.13	-.516	.037	.817		
EFSM2_9.10	3.13	-.620	.303	.850		

Table 5 shows the pilot result for the Effectiveness of Fire Safety Management constructs which produces mean values ranging from 2.45 to 3.36. The values of skewness and kurtosis were all the threshold of -/+2 (George & Mallery, 2010) except for EFSM2_9.3 and EFSM2_9.6 which have kurtosis value above 2. All the variables under the construct have strong factor loadings which cumulatively explained 58.47 percent of the variance which is considered satisfactory. The reliability of the construct was assessed using Cronbach's alpha coefficient which produced a value of 0.916 above the recommended minimum threshold of 0.7 (Tabachnick & Fidel, 2007; George & Mallery, 2010; Pallant, 2011).

This result indicated that the result obtained is adequate; the data is normally distributed and reliable. Hence, the instrument is considered valid for the main survey of the research except for EFSM2_9.3 and EFSM2_9.6 which require further amendment.

4.6 Descriptive of the Aggregate Constructs of Stakeholder

Table 6 - Descriptive of the Aggregate Constructs of Stakeholder

	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
MgtandMtnance	3.08	.577	-1.103	.327	3.329	.644
AdFSSE	3.28	.752	-.096	.327	-.665	.644

ConFSSE	3.43	.616	-.375	.327	-.524	.644
ImpFSSE	4.07	.721	-.326	.327	-.890	.644
AdFSCB	3.68	.636	.159	.327	-.005	.644
ConFSCB	3.61	.636	-.173	.327	.104	.644
ImpFSCB	3.97	.574	-.129	.327	.373	.644
EFSM	3.10	.626	-.873	.327	1.164	.644

Table 6 shows the descriptive of the constructs used in the FSM stakeholders' questionnaire. The result produced mean values ranging from 3.08 to 4.07 with low dispersion as indicated by standard deviation values of less than 1. The values of skewness and kurtosis are all within the recommended threshold of -/+2 (George & Mallerry, 2010). The results show that all the constructs of the study are normally distributed.

5. Conclusion

This paper discusses pilot testing of a questionnaire administered among the staff the facilities management, occupational safety health and environment (OSHE) and security departments from selected universities in Johor Malaysia of HEIs buildings. A total of 60 questionnaires were administered, and 55 were found useful from 53 returned. Four constructs were assessed for normality, reliability, factorability. All the results gave a favourable indication to proceed with the core survey with little adjustments.

Acknowledgements

References

Billington, M. J., Copping, A., & Ferguson, A. (2002). Means of escape from fire. John Wiley & Sons

British Standards Institution. BSISO/TR13387: Fire safety engineering, part1: Application of fire performance concept to design objectives. BSI, London, UK. (1999)

Chow, W. K. (2001). Review on Fire Safety Management and Application to Hong Kong, 3(1), 52–58.

Cohen, L., Manion, L., & Morrison, K. (2013). *Research methods in education*. London: Routledge

Collins, J., and Hussey, R. (2003). Business research. Basingstoke NH: Palgrave, Macmillan.

Creswell, J. W. (2013). Research design: Qualitative, quantitative and mixed method approaches. Sage.

Fink, A. (2006) How to Conduct Surveys: A Step-by-Step Guide. 3rd Edition, Sage Publications

George and Mallery (2010). SPSS for windows a step by step: A Simple Guide and Reference

Hassanain, M. A. (2009). Approaches to qualitative fire safety risk assessment in hotel facilities. Structural Survey, 27(4), 287–300.

Howarth, D. J., Kara- Zaitri, C. Disaster Prevention and Management, An International J. 8, 5 (1999)

Lodico, M. G. and Spaulding, D. T. and Voegtle, K. H. (2006) Methods in Educational Research: From Theory to Practice. JOSSEY-BASS A Wiley Imprint. The United States of America. First Edition.

Mathers, N., Fox, N., Hunn, A. (2007). Surveys and Questionnaires, The NIHR RDS for the East Midlands / Yorkshire & the Humber

Muijs, D. (2004). Doing Quantitative Research in Education with SPSS. *SAGE Publications*.

Pallant, J. (2011). SPSS Survival Manual 4th edition: A step by step guide to data analysis using SPSS: Allen and Unwin, Crows Nest, Australia.

Ramachandran, G. (1999). Fire safety management and risk assessment. *Facilities*, *17*(9/10), 363–377.

Society of Fire Protection Engineers. (2005). SFPE Engineering Guide to Application of Risk Assessment in Fire Protection Design. *SFPE, USA*.

Tabachnick, B. G., & Fidell, L. S. (2007). Using multivariate statistics. Allyn & Bacon/Pearson Education.

Yeung, C. H. (2007). Fire Safety Management of Public Rental Housing in Hong Kong, *9*(4), 163–176.