

Analysis of the Contributing Factors for Fatal Accidents due to Falls from Heights in Malaysia and the USA

Abderrahim Zermane¹, Mohd Zahirasri Mohd Tohir^{1*}, Mohd Rafee Baharudin² and Hamdan Mohamed Yusoff¹

¹Safety Engineering Interest Group, Department of Chemical and Environmental Engineering, Faculty of Engineering, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

²Department of Community Health, Faculty of Medicine & Health Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

ABSTRACT

Working at heights has always been a concern for the process industry and construction industry. According to recent statistics, falls from heights are the leading cause for at least a third of all construction accidents, based on the accident reports from Malaysia, United States of America (USA) and Great Britain. Therefore, the aim of this research is to investigate the contributing factors for fatal accidents due to falls from heights based on published official data by government agencies such as Department of Occupational Safety and Health (DOSH) in Malaysia and Occupational Safety and Health and Administration (OSHA) in the USA. Thorough risk analysis of accidents due to falls from heights is needed as a step to improve the safety of workers and reduce the number of fatalities. The methodology used was developed through an in-depth literature review from relevant

publications that discussed falls from heights investigations ranging from individual characters to management commitment and site conditions. The data is available and accessible to the public via OSHA and DOSH and can be obtained by browsing their websites. The data were analysed based on the relevant understanding of the description mentioned in the accident reports and its relationship with the contributing factors. Eventually, from the analysis, the factors which affect more the numbers of

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E-mail addresses:

zermane.abderrahim@gmail.com (Abderrahim Zermane)

zahirasri@upm.edu.my (Mohd Zahirasri Mohd Tohir)

mohdrafee@medic.upm.edu.my (Mohd Rafee Baharudin)

my_hamdan@upm.edu.my (Hamdan Mohamed Yusoff)

*Corresponding author

fatal accidents due to falls from heights were obtained. In this study, 105 fatal accidents due to falls from heights from Malaysia data and 101 fatal accidents from USA data were selected through a precise selecting process and analysed to determine which factor was the highest contributor to increasing the number of fatal workplace accidents due to falls from heights. Results indicate that a lack of effective management is the highest contributor to falls from height fatal accidents.

Keywords: Construction, falls from heights, fatal accidents, occupational safety, risk analysis

INTRODUCTION

Workplace Fatal Accidents (WFAs) have been and still are the main concern for many governments and employers due to the loss of workers lives. Loss of a person's life, regardless of whether high or low rates are still considered a costly loss for any employer, either economically or socially. That drives researchers to investigate these phenomena, therefore, various studies have focused on finding a solution for such a dilemma. Over the years, some countries have made a recognizable progress in reducing the number of accidents which resulted in positive improvement in reducing fatalities such as the United Kingdom, these improvements interpreted in real life statistics which indicated that the number of WFAs has dropped from 2.1 per 100,000 workers in 1981 to 0.5 per 100,000 workers in 2018/2019 (Health and Safety Executive, 2018). Similar challenges exist in other countries such as the United States and Malaysia, while they attempted to solve the fatalities problem hoping to achieve the same level of success as the United Kingdom, unfortunately, they did not achieve the same results in spite of the undeniable effort and research conducted. In Malaysia, statistics showed that the number of WFAs increased in the period between 2014 and 2017, the number went from 4.21 per 100,000 workers to 4.90 per 100,000 workers in Malaysia (Malaysia Department of Occupational Safety and Health, 2018). In the United States, statistics showed that the numbers went up from 3.3 per 100,000 workers to 3.5 per 100,000 (U.S. Bureau of Labour Statistics, 2014, 2018). According to published data, Falls From Heights (FFH) contributed to the whole number of WFAs by 30% in the United Kingdom which was interpreted into 35 fatal accident totals in 2017/2018 (HSE, 2018). The percentage was 39% in the United States which was interpreted into 381 fatal accident in 2017 and finally, 46% in Malaysia (Ayob et al., 2018) which was interpreted into 16 fatal accident in 2017/2018 (Malaysia Department of Occupational Safety and Health, 2018).

A considerable amount of literature has been devoted to finding the factors that affect workplace fatal accidents from different aspects in different countries to uncover these accidents economical and sociological effects. Kum and Sahin (2015) investigated arctic accidents, in spite of the differences between their study and this study, it was still beneficial

to this study by adapting the methodology used to process the raw data that helped to develop the structure of this study.

Ayob et al. (2018) focused on workplace fatal accidents in the Malaysian construction industry by using a descriptive exploratory survey to determine both the patterns and contributing factors for fatal accidents. The results indicated the locations with the highest numbers of WFAs and types of accidents from the brief reports provided by the Department of Occupational Safety and Health in Malaysia. Results were too general as they only gave immediate causes for each type of accident. On the other hand, a study by Wong et al. (2016) associated human factors and root causes analysis to investigate falls from heights in Hong Kong construction industry using a systematic approach to analyse reports from the coroner's office. Results revealed that human factors were strongly linked to falls from heights fatal accidents and divided the cases into four general classes. The results from this study are a step forward to discovering the causes of falls from heights accidents, but it is narrowed by only analysing the human factors in falls from heights which may collide with other factors such as site conditions or weather conditions.

Furthermore, a study by Nadhim et al. (2016) was conducted in detail a review of all the studies that were related to finding factors or causes that led to fatal accidents to falls from heights by using three-phase methodology; searching the internet, selecting and analyzing using several statistical methods. The papers were clustered by journals, date, type of work, location, and accidents contributing to the most falls from accidents. The results of this study were limited and did not focus on finding the actual factors behind fatal accidents, instead of based on sample size. Results led to the discovery of several factors that affected falls from heights which are: risky activities, individual factors, site conditions, and management, agent and weather conditions. Besides that, earlier studies such as Huang and Hinze (2003) had tackled this issue and analyzed case reports in spite of the hardships faced at that time. The study focused on analysing case reports collected from the OSHA in the USA at the time. The data were clustered and analyzed based on several variables such as age, gender, type of fall and height of fall causes of fall accidents. Results indicated that the lack of training is the major contributor to fall from heights accidents especially in occupations such as a roofer, carpenters, labourers, and structure metalworkers. Several variables that control the occurrences of these accidents changes have been occurring since the time this paper was published; technology and safety awareness have been developed and several variables could affect the result of this study.

On a more precise note, this topic has not received a great deal attention both inside and outside of Malaysia such as the study by Mohammad and Hadikusumo (2017) which identified safety intervention practices in the Malaysian construction industry. The outcome was to determine a guide for behavioural safety performance in the construction industry. Although the approach is a good start towards behavioural safety, the study did not focus

on finding solutions for the current high numbers of accidents. The study if implemented correctly, could contribute to the long-term effect. Other studies such as Ismail et al. (2012); Marhani et al. (2013); Ranjan (2019); Saifullah and Ismail (2012) and Zin and Ismail (2012), focused mostly on behavioural factors and management systems.

The opposite goes for the USA, as several studies have been published that focused on workplace fatal accidents due to falls from height, some of the studies tried to implement technology into occupational safety and health such as Antwi-Afari and Li (2018); Gómez-de-Gabriel et al. (2019); Jebelli et al. (2016); Ohdo et al. (2011); Umer et al. (2018); Yang et al. (2017) and Zhang et al. (2015) but the statistics published each year indicate the opposite, as the number of accidents in the United States had increased. That leads to the believe that there is a gap that has to be addressed. Therefore, this research addresses falls from heights in terms of the contributing factors such as human, managerial and weather factors as well as variables such as location, date, type and time of fall to determine which factors affect more of these variables and to compare the obtained results from different countries.

MATERIALS AND METHODS

This study was conducted to detect the factors that could affect workplace fatal accidents and the time and location patterns that could increase or decrease the number of fatal accidents in Malaysia and the United States of America. The study acknowledges that knowing these factors in different accidents scenarios could greatly contribute to preventing future accidents.

Data Collection

In order to collect the necessary data, this research used a database available to the public from two different occupational safety and health government agencies. Accident reports published by the Department of Occupational Safety and Health in Malaysia (DOSH) and the Occupational Safety and Health Administration (OSHA) in the USA were selected in this respect.

Data Selection

When analysing a specific type of accident in both DOSH and OSHA database, the information is usually either incomplete or the description is rather short and does not contain the full details on the timeline of the accident. This requires a thorough search for a specific type of accident, which can be performed by consulting accident reports from different databases. Due to the lack of the full reports by DOSH and OSHA which included just a summary that had a few details such as location referred to as State, date,

accident type and a brief description of the accident sequence. All the related data would be collected based on the description and provided a type of fall. Table 1 shows the sample reports published by DOSH and OSHA. Accident identifier is an added reference to put all accidents in chronological order, the date indicates the date of the accident, the state is the location of the accident, accident type indicates how the worker died and finally the description is a short summary of the accident events.

Table 1

Sample of reports published by both DOSH and OSHA

Accident Identifier	Date	State	Accident Type	Description
MY001	06/09/2018	Pulau Pinang	Died falling from a height	A general worker had fallen from level 6 as he was walking the scaffold's temporary ladder i) Unsafe access to the temporary ladder ii) Wall opening was not properly covered
US001	03/29/2018	Georgia	A worker died in fall from a roof.	At 2:54 p.m. on March 29, 2018 , an employee was walking across a low sloping metal roof on a steel building during the repair of a roof leak. The employee stepped on a fiberglass skylight and fell through . The employee fell 16 feet to the concrete floor . The employee sustained multiple blunt force trauma injuries and later died.

Among these reports, an extensive selecting process was carried out. For DOSH, due to the low number of accident reports published, it was not necessary to use any method to select the data, but just manually collecting all the cases with falling from heights title. The number was only 382 accidents in the timeframe of 8 years (from 2010 to 2018), falls from heights accounted for 27.48% of all the published cases which was interpreted into 105 cases report.

The opposite was for the USA, due to the extensive number of accidents and a variety of accident types in the OSHA websites, a filtering method was implemented to determine the falls from heights accidents among others. The method filtered accidents with only the word “fall” included in the description and filtered all workplace falls from heights/elevation accidents. Another variable was used to select the cases reports, not all cases published

had a description of the accidents, only accidents that had a description were selected. A total of 101 accident in the period of 6 months (from October 2017 to March 2019). Most reports included only the immediate causes of the accidents, there was no deeper analysis to extract the root causes and the contributing factors. The highlighted areas in Table 1 are an example of how accident description was used to determine which category of factors that accident would be placed.

Data Analysis

Classification of Factors Used in the Study. To provide systematic analysis for the work, a proven classification of factors contributing to accidents scheme had been adopted for this work. The classification was obtained from the work done by Nadhim et al. (2016) and is shown in Table 2.

Table 2

Classification of factors contributing to accidents from Nadhim et al. (2016)

Contributing Factors Classification	Contributing Factors which Lead to Accidents
Risky Activities	Working at height: With complexity, hardship, prolong tasks
Individual Characteristics	<ul style="list-style-type: none"> - Demography: Age, gender, weight, ethnicity. - Knowledge level: Lack of education, experience, training. - Human behaviours: Misjudgement, attitude, unsafe behaviour & carelessness. - Workers health/characteristics: Fatigue, sleep deprivation or depression
Site Conditions	<ul style="list-style-type: none"> - Insufficient lighting & illumination - Unprotected/defective platform & surface
Organization/ Management	<ul style="list-style-type: none"> - Small-medium sized companies: Lack of training programs - Contractors & Sub-contractors: Lack of proper/safe equipment - Shift work: Night shifts and break periods - Project timeline: Pressure to accelerate
Agent	Improper position or defective: Ladder/scaffold (erecting/dismantling)
Weather/ Environmental Conditions	Frost, snow, heavy rain, humid extreme temperatures, noise, dust.

Table 2 indicates all the factors that could affect the number of falls from heights accidents, the same factors would be used to determine which would affect the number of accidents based on the descriptions from reports collected from both DOSH and OSHA. An example of how the collected data was interpreted into the classification is shown in Table 3. Based on the description of the accidents in Table 1, the authors categorised the accidents into respective classification. Each accident could have one or more factors influencing it.

Table 3

Sample of the analysed data

Accident Identifier	Date	Location	Risky Activities	Individual Characteristics	Site Conditions
MY001	06/09/2018	Pulau Pinang			x
US001	03/29/2018	Georgia		x	x

Accident Identifier	Date	Location	Organization/ Management	Agent	Weather/ Environmental Conditions
MY001	06/09/2018	Pulau Pinang		x	
US001	03/29/2018	Georgia	x		

RESULTS AND DISCUSSION

Analysis of Malaysian Data

Results in this section were the outcome of an extensive systematic analysis of workplace fatal accidents reports obtained from DOSH and OSHA. A total of 206 fatal accident reports were analyzed to extract the factors that can affect accidents by both date and location (Table 3). Results from the analysis of 105 accident reports from Malaysia found that several factors could affect accidents numbers, the two main contributing factors were management and individual characteristics, other factors such as risky activities and agent had a small or negligible effect, weather and environmental factors were not a factor due to the lack of information on the accident reports description. Furthermore, different locations and dates seem to have an effect on these accidents.

Classification by Year

Regarding the dates of the accidents (Figure 1), 2014 was the highest in terms of accident numbers which helped identify the contributing factors that could have a direct and/or indirect effect on falls from height accidents.

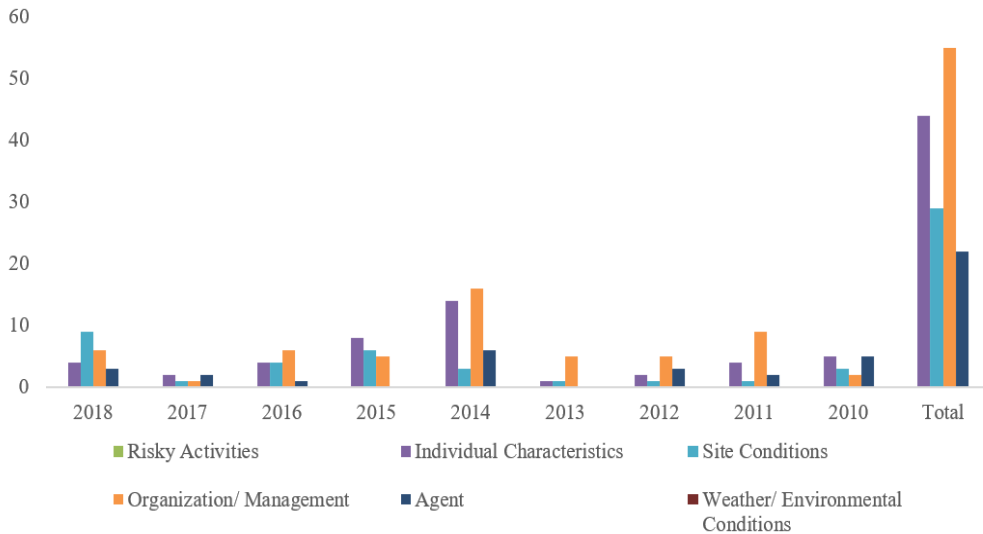


Figure 1. Malaysian data by date

Table 4 shows the number of accident reports and the number of factors affecting those accidents by date. The total number of accidents was 105 based on the reports collected from DOSH and the total of contributing factors was 151 that were extracted in accordance to the accident report description, a factor or more could affect one accident. The average of 11 accidents (10%) was recorded in three different years which were 2011, 2012, and 2016 which indicated that with all the laws and regulations available 11 accidents per year still happened. The year 2014 recorded the highest number of accidents with a total of 28 accidents that was interpreted into 26% of all accidents; 15 of these accidents were in the state of Johor and 4 in the state of Pulau Pinang. In the following year 2015 was ranked next with 16 accidents (15%) and it spread over several states. There was a relatively low number of accidents recorded in 2017 with 4 accidents. These results could be considered a progress if the year 2018 did not have 12 accidents; meaning that the decrease in accidents numbers in 2017 did not necessarily signify an improvement in preventing falls from heights accidents but it might be caused by external factors; that were likely linked to underreporting or more likely that the accidents occurred during that year were not accidents due to falls from heights. The available statistics support this claim as DOSH in 2017 recorded a higher number of worker fatalities with 3.5 per 100,000 workers, which is still a valuable point to consider when trying to extract which factors affect work at heights.

Table 5 shows that the contributing factors registered their peak in 2014 which also had the highest number of accidents but that does not necessarily mean that there exists a relation with accident number and the contributing factors since 2018 was the second-highest number of contributing factors but fewer accidents numbers than 2015. According

to Table 5, the results support the conclusion from the table where management and individual characteristics are the main contributing factors that could affect accidents numbers. Nevertheless, the year 2018 witnessed the appearance of a new factor which was site conditions, that was overlooked in the past years. From the data in Table 5, it was noticeable that site conditions started contributing to accidents number since the year 2015 until it reached its highest number in 2018 which was 9. On the opposite, there was an improvement in management and individual characteristics factors from 16 in 2014 to 5 and then steadily 6 in 2018 and 2016. The same goes for individual characteristics which went down from 14 in 2014 to 8 in 2015 and then steadily at 4 in 2016 and 2018 which is a good indicator that these factors are getting some attention but the number of accidents is still the same or increasing, focusing on some factors and neglecting others is not as effective but it is still considered as an improvement since site conditions could be considered as reactive factor.

Table 4

Malaysian data by date

Year	Number of Accidents	Contributing Factors
2018	12	22
2017	4	6
2016	11	15
2015	16	19
2014	28	39
2013	6	7
2012	11	12
2011	11	16
2010	6	15
Total	105	151

Table 5

Classification of Malaysian data based on date

Year	Classification of Contributing Factors to Accidents					
	Risky Activities	Individual Characteristics	Site Conditions	Organization/ Management	Agent	Weather/ Environmental Conditions
2018	-	4	9	6	3	-
2017	-	2	1	1	2	-

Table 5 (Continued)

Year	Classification of Contributing Factors to Accidents					
	Risky Activities	Individual Characteristics	Site Conditions	Organization/ Management	Agent	Weather/ Environmental Conditions
2016	-	4	4	6	1	-
2015	-	8	6	5	-	-
2014	-	14	3	16	6	-
2013	-	1	1	5	-	-
2012	-	2	1	5	3	-
2011	-	4	1	9	2	-
2010	-	5	3	2	5	-
Total	-	44	29	55	22	-

Classification by Location

Regarding the location of the accidents (Figure 2), three cities emerged as they had the highest numbers of accidents as the other states which were Johor, Pulau Pinang and Kuala Lumpur, these numbers eventually led to noticeable results on which contributing factors could positively affect accident numbers.

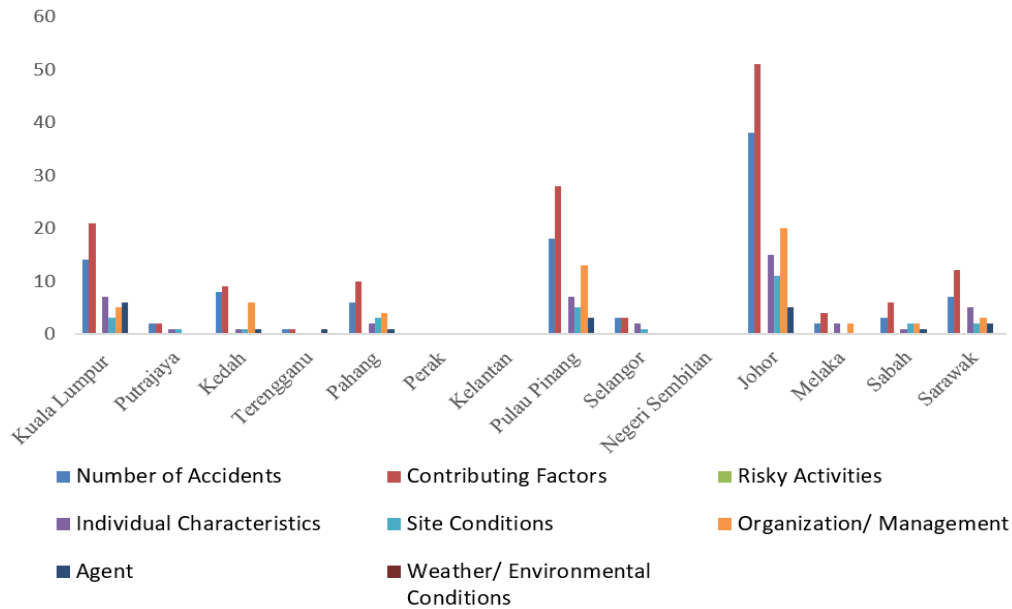


Figure 2. Malaysian data by location

Table 6 shows that Johor ranked the first with 38 accidents out of 105, a total of 36%, secondly came Pulau Pinang with 18 accidents; 17% of all accidents and third was Kuala Lumpur that contributed to 13% of all accidents which was 14 accidents. These numbers indicate that the focus to reduce the numbers of fatal accidents should be as these three states combined contributed to 66% of the total of accidents as in 70 accident in 9 years, the rest of the states had fewer accidents but it is not a major concern since the highest was 8 accidents in 9 years in Kedah, which is also one of the biggest states in Malaysia.

The size of the state is a major factor in accidents numbers since the budget will be bigger and therefore more projects which will eventually lead to increasing the workforce that will affect accident numbers and the factors contributing to them directly. The increase in accident numbers meant the increase in the contributing factors. Johor ranked first with 51 contributing factors for 38 accidents, which means 34% of all the contributing factors (Table 7). This indicates that an accident does not necessarily have to have only one factor but several factors possibly affecting the transformation from a near miss to a non-fatal or a fatal accident. Pulau Pinang was second with 19% with 28 factors for 18 accidents, an average of 1.5 factors for each accident.

Table 6
Malaysian data by location

Location	Number of Accidents	Contributing Factors
Kuala Lumpur	14	21
Putrajaya	2	2
Kedah	8	9
Terengganu	1	1
Pahang	6	10
Perak	-	-
Kelantan	-	-
Pulau Pinang	18	28
Selangor	3	3
Negeri Sembilan	-	-
Johor	38	51
Melaka	2	4
Sabah	3	6
Sarawak	7	12
Perlis	3	4
Total	105	151

The other locations lack the alarming accident numbers, which either means that falls from heights is not a major concern in these states or that there is a shortage of reporting accidents. These states most likely had small projects where a safety site supervisor was not a requirement by DOSH and the supervisor was the one that had to remind the workers of safety. In some cases, there was no supervision at all but it still provided necessary data that helped with identifying the contributing factors to fatal falls from heights. It could also indicate that Johor, Pulau Pinang and Kuala Lumpur had received more development projects during that time period, unlike the other states. The highest number for the contributing factors was either organization/management or individual characteristics, these two combined are 66% of all contributing factors, which highlight the main problem that was management involvement and human factors. While clearly in Johor and Pulau Pinang management was the main issue; Kuala Lumpur seemed to have a problem with human factors and the individual characteristics of the workers which could relate to (Zerguine et al., 2017).

Table 7

Classification of contributing factors based on Malaysian states

Location	Classification of Contributing Factors to Accidents		
	Risky Activities	Individual Characteristics	Site Conditions
Kuala Lumpur	7	7	3
Putrajaya	-	1	1
Kedah	-	1	1
Terengganu	-	-	-
Pahang	-	2	3
Perak	-	-	-
Kelantan	-	-	-
Pulau Pinang	-	7	5
Selangor	-	2	1
Negeri Sembilan	-	-	-
Johor	-	15	11
Melaka	-	2	-
Sabah	-	1	2
Sarawak	-	5	2
Perlis	-	1	-
Total	-	43	29

Table 7 (Continued)

Location	Classification of Contributing Factors to Accidents		
	Organization/ Management	Agent	Weather/ Environmental Conditions
Kuala Lumpur	6	-	-
Putrajaya	-	-	-
Kedah	6	1	-
Terengganu	-	1	-
Pahang	4	1	-
Perak	-	-	-
Kelantan	-	-	-
Pulau Pinang	13	3	-
Selangor	-	-	-
Negeri Sembilan	-	-	-
Johor	20	5	-
Melaka	2	-	-
Sabah	2	1	-
Sarawak	3	2	-
Perlis	1	2	-
Total	55	20	-

Management is considered a deeper factor since it does not affect accidents happening directly unlike other factors such as agent, site conditions. Human factors can be both a direct and indirect factor, this indicates how deep the issue on some states among others can be.

Analysis of USA Data

The same analysis in Malaysia was applied for the data collected from OSHA. A total of 101 workplace fatal accident reports due to falls from heights were analysed to determine which factor could affect the arising numbers of accidents by date, type of fall and time of fall (Table 8). Results found were identical to those from the analysed Malaysian data where management and individual characteristics could drastically affect accidents due to falls from heights.

Classification by Date

Table 8 shows that October 2017 had the highest number of accidents in the period of 6 months with 23 accident 22%, followed by December 2017 and November 2017 with

22 and 20 accidents respectively. On the other hand, February 2018 recorded the lowest number of accidents with 11 accidents followed by January 2018 with 12 and finally in March 2018 with 13 accidents as seen in Figure 3. What these numbers conclude is that the last months of the year are categorized in most the cases with the end of projects and employers need to catch deadlines by finishing the scheduled tasks before the end of the year. Rushing tasks could lead to neglecting safety rules and regulations which resulted in recording a higher number of accidents and factors leading to these accidents. It also means that employees are tired of working all year and trying to finish their tasks so they could enjoy their holiday earlier. Both human and managerial factors could be the results of the high numbers of accidents especially at the end of the year.

Table 8
USA data by date

Month/Year	Number of Accidents	Contributing Factors
March 2018	13	22
February 2018	11	18
January 2018	12	16
December 2017	22	29
November 2017	20	25
October 2017	23	32
Total	101	142

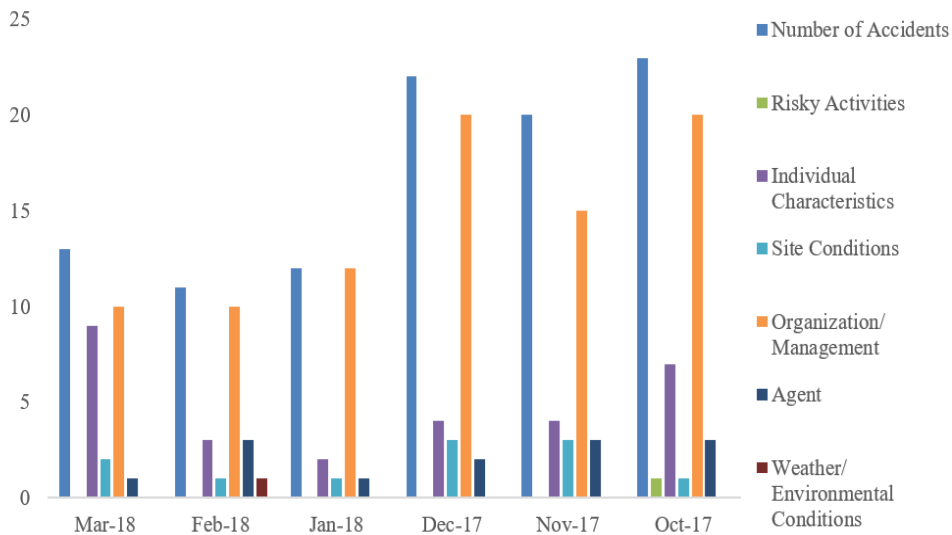


Figure 3. USA data by date

Table 9 also indicates that there was a considerable drop in accidents numbers by almost 50% from 22 accidents as an average in 2017 last quarter to 12 accidents as an average of 2018 first quarter. That is due to several reasons including that management did not rush projects deadlines as an urgent matter which proves more that management commitment has a direct effect in accident numbers. It also means that workers are back from their long year end holiday and that they got plenty of rest and spent time with their family which also are individual characteristics that share the same effect as management in controlling the numbers of accidents.

Management and individual factors such as scheduling work times, extra shifts and break periods could directly affect workers physically and mentally and reducing and increasing work stress which could have a positive effect on performing work safely.

Table 9
Classification of the USA contributing factors by date

Month/ Year	Classification of Contributing Factors to Accidents					
	Risky Activities	Individual Characteristics	Site Conditions	Organization/ Management	Agent	Weather/ Environmental Conditions
March 2018	-	9	2	10	1	-
February 2018	-	3	1	10	3	1
January 2018	-	2	1	12	1	-
December 2017	-	4	3	20	2	-
November 2017	-	4	3	15	3	-
October 2017	1	7	1	20	3	-
Total	1	29	11	87	13	1

Classification by Type of Fall

Table 10 presents the types of fall from heights which is a different type of data that is not available in reports extracted from the Malaysian reports. According to Table 10, falls from roofs are the most common type of accidents in the United States, with 43 out of 101 accidents (42%) in 6 months. Secondly comes scaffolds and ladders with 22 (21%) and 18 (17%) respectively. It is clear that the focus should be determining the factors affecting tasks performed on roofs where there is hardly any supervision or measures of preventing these falls. Rules and regulations by OSHA could be very beneficial but there is no follow up.

Table 10

The USA data by types of fall

Type of Fall	Number of Accidents	Contributing Factors
Roof	43	60
Ladder	18	22
Scaffold	22	35
Other	18	28
Total	101	145

Table 11 shows that management and individual characteristics are the main factors contributing to accidents with 60% and 20% respectively. Most roofing jobs are conducted by small and medium contractors where rules of safety are not as important as finishing the job early and get paid. Most clients do not bother to do a background check on safety records of contractors, unlike big companies that have a reputation to protect. Other types of fall are scaffolds and ladders which are what most workers use to perform work at height task. The contributing factors show that management and individual characteristics contribute to most of these accidents either by not supervising workers on roofs, scaffolds and ladders (Figure 4). If a worker is at one place for an extended period of time, he would lose his sense of direction and may blend with his surrounding environment that leads to loss of balance. Another cause could be vertigo as the workers fail to report that they have vertigo and management does not commit much to asking or performing the test on potential workers that would have to work at heights. Other factors could be neglected due to the minimal contribution to accidents numbers.

Table 11

Classification of the USA contributing factors by type

Type of Fall	Classification of Contributing Factors to Accidents					
	Risky Activities	Individual Characteristics	Site Conditions	Organization/ Management	Agent	Weather/ Environmental Conditions
Roof	-	10	6	39	4	1
Ladder	-	6	-	16	-	-
Scaffold	1	11	2	17	4	-
Other	-	3	4	16	5	-
Total	1	30	12	88	13	1

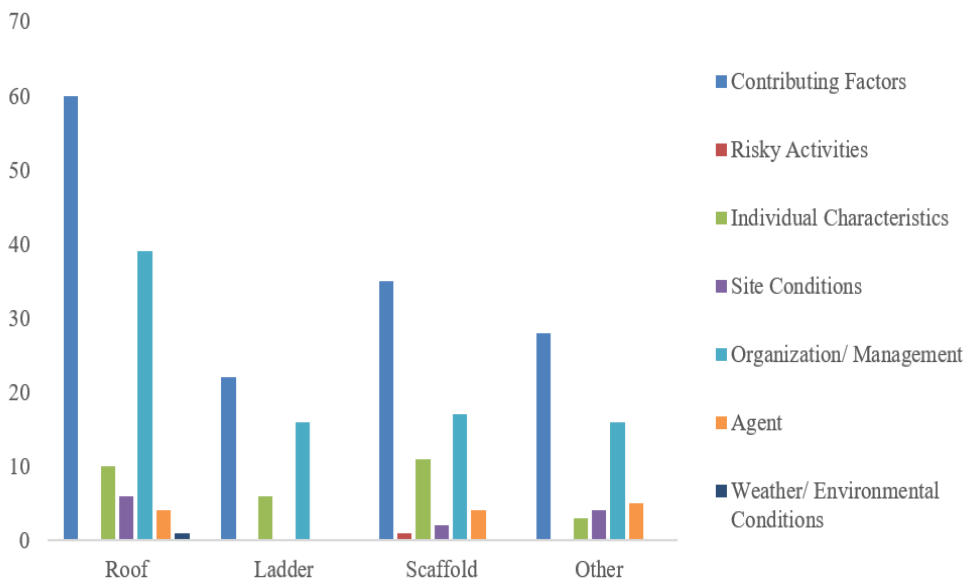


Figure 4. USA data by type of fall

Classification by the Time of Fall

Table 12 shows that fatal accidents occurred more frequently from 8 a.m. to 12 p.m. (42%), 12 p.m. to 4 p.m. (29%) and 4 p.m. to 8 p.m. (20%) than in other time periods. These periods could be considered the normal work period for most companies. The highest rates of accidents occurred at the beginning and middle job period, whereas the third time period may indicate the regular time table but it may also mean overtime or shift work (Figure 5). It is a clear indication that most supervisors do not bother doing the morning routine which is to check any changes on-site that happened overnight, performing their toolbox talks which work as a reminder for safety rules and as an induction to any changes on-site according to Huang and Hinze (2003), these daily supervisors tasks can be considered both managerial and human factors.

Table 12

The US data by time of fall

Time	Number of Accidents	Contributing Factors	Time	Number of Accidents	Contributing Factors
12 a.m. - 4 a.m.	1	1	4 p.m. - 8 p.m.	19	31
4 a.m. - 8 a.m.	2	3	8 p.m. - 12 a.m.	4	5
8 a.m. - 12 p.m.	40	57	Total	94	135
12 p.m. - 4 p.m.	28	38			

Table 13 shows that the most influencing factors are management 57% and individual factors 19% of all contributing factors to accident numbers and that is due to the management work schedule and negligence of workers mental fatigue regardless of physical fatigue by forcing additional hours. This can lead to a case of work stress where the worker would either try to rush the task without paying attention to safety rules or that there is some site modification that happened overnight during a night shift or an after scheduled work hours. These changes, if not communicated correctly by management to workers, may lead to unwanted events such as fatal accidents especially if it involves work at heights activities according to Kaskutas et al. (2013).

Table 13

Classification of the USA contributing factors by time

Time	Classification of Contributing Factors to Accidents					
	Risky Activities	Individual Characteristics	Site Conditions	Organization/ Management	Agent	Weather/ Environmental Conditions
12 a.m. - 4 a.m.	-	-	-	1	-	-
4 a.m. - 8 a.m.	-	1	-	2	-	-
8 a.m. - 12 p.m.	1	10	6	35	5	-
12 p.m. - 4 p.m.	-	8	1	26	3	-
4 p.m. - 8 p.m.	-	8	3	16	3	1
8 p.m. - 12 a.m.	-	1	-	3	1	-
Total	1	28	10	83	12	1

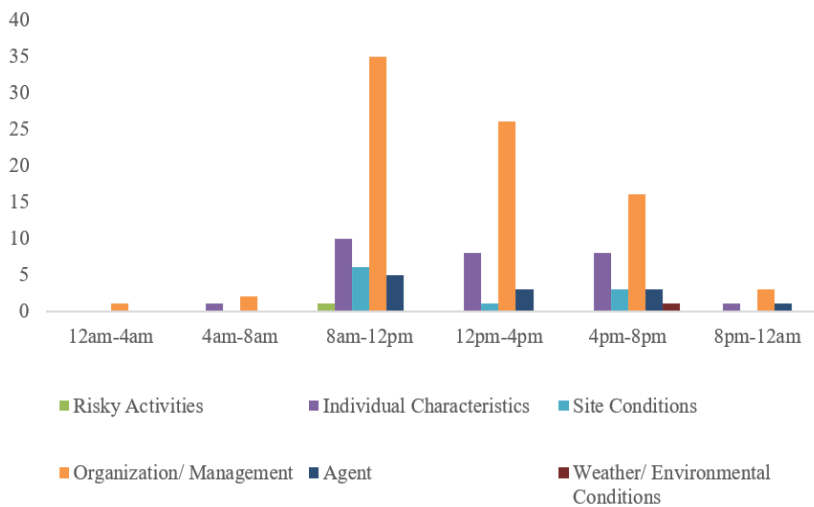


Figure 5. USA data by time of fall

It is fair to state that factors can positively or negatively affect the work environment by influencing accidents by turning near misses into an actual fatal or non-fatal accident. Management involvement in safety matters can directly affect what type of accidents happens and prevents fatal accidents from occurring by implementing an effective management system according to rules and regulations that are made through countless research such as by Ismail et al. (2012). Individual characteristics and human factors could also be an important factor to consider where a worker should be aware of his surroundings and have good safety awareness because safety is not just some rules to follow but a strong conviction that it is his ally.

Comparison between Malaysia and the USA Data

Malaysia and USA are two different countries, whether geographically or culturally. That does not necessarily mean that they do not share some common ground. Both Malaysia and the USA have high rates of fatal falls from heights (Malaysia Department of Occupational Safety and Health, 2018). Regardless of the size where the USA is larger than the size of Malaysia with 9,833,520 km² compared to 330,803 km² and a population where the USA is ten times the population of Malaysia with 327,167,434 million compared with 32,049,700 million. Despite these differences, Malaysia and the USA have both faced some challenges regarding falls from heights accidents; countless efforts went into trying to reduce fatal falls from heights that they proved to be a threat to be recognized.

Previous data showed in Table 4 indicated that the number of workplace fatal accidents due to falls from height happened in Malaysia in the past 9 years which was 105 accidents could occur in the USA in a period of only 6 months with 101 accidents due to the population and size of both countries. Regardless of that, the fatal falls from heights accidents percentage in Malaysia is higher than the one in the USA with 46% to 39%. The USA has more surface to cover and more individual projects to control, safety specialist will have a hard time to cover all that area, especially that most of the roofing projects will not last more than few weeks. The opposite goes for Malaysia, Johor as the largest state with recorded fatal accidents, does not have many small projects but many big developments according to Construction Industry Development Board (CIDB) which can be easier to control.

No matter what differences Malaysia and USA share, it is clear that falls from heights are a major concern for both countries according to yearly published reports by DOSH (Malaysia Department of Occupational Safety and Health, 2018) and OSHA (U.S. Bureau of Labour Statistics, 2018). Previous data show that both countries care a great deal for this challenge, both have dedicated administration specialized in workplace accident; DOSH in Malaysia and OSHA in the USA. Both administrations provided an open database for fatal accidents and produced countless rules and regulations in an effort to eliminate or

at least minimize fatal accidents. The similarities between the two countries do not stop here, based on the analysed data from both Malaysia and USA, the two countries share the same two factors that can influence works at heights which are management and individual characteristics, no matter what type of data was analysed. For Malaysia, managerial factors recorded 55 factors compared with an average of 85 for the USA. Individual characteristics factor did not fall far from the tree wherein Malaysia it recorded an average of 43 compared with an average of 29 for the USA.

It is definite from the above results that Malaysia and the USA share common factors that could affect workplace fatal accidents due to falls from heights. Management involvement in safety matters and individual and human factors are the two most influencing factors in accidents happenings. Regardless of the types of data analysed, there is always an apparent indication that points towards management and individual factors. These two factors should be addressed immediately due to the effect they have on both workers and employer's moral, legal and economic costs.

CONCLUSION

Construction is one of the vital sectors in the international economy. Works at height are part of construction daily activities. Falls from heights accident is a problem that the construction sector is suffering from all over the world. It was necessary to address that problem in this research due to the increasing numbers of workplace falls from heights accidents. This study contributes to the body of knowledge by finding the contributing factors to fatal falls from heights accidents relying on two types of statistics produced by Malaysia and the USA. Based on the study of Malaysian and USA data, this study found that the two major factors that lead to fatal falls from heights accidents are managerial factors, that include sub-factors such as management involvement in safety, safety management systems, safety communications, work at heights safety equipment purchasing, supervision of employees, initial and pre-task training and safety culture within the company can greatly affect the occurrence of fatal accidents. By implementing an effective management system, fatal accidents can easily change into a non-fatal or near misses. Human factors and individual characteristics of workers are the second-highest contributing factors and go hand by hand with managerial factors. Another outcome of the study is that fatigue could greatly affect workplace accidents, not just physical fatigue but also mental fatigue. Future studies should focus on both managerial and human factors, this study was conducted based on the reports published by only two countries. The reports used in this study had limited descriptions. The study focused only on fatal accidents due to falls from heights.

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