

TECHNICAL REPORT

A STUDY OF FATAL AND NON-FATAL ACCIDENTS IN CONSTRUCTION SECTOR

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Abstract: Occupational accident in the construction sector in 2010 alone includes 66 fatal and 54 non-fatal. The objectives of this study are; to study fatal and non-fatal accident and to determine contribution of fatal and non-fatal accident to the total number of accident. The result indicates that there is no clear positive or negative trend in the number of fatal and nonfatal accident from year 2002 – 2010. Furthermore, the result of the Sensitivity Analysis shows that fatal accidents (53.53%) contribute more to accident rates than nonfatal accident (47.46%). This study provides useful information as regard to the contribution of fatal and nonfatal accident to the total number of accident and the key impact variable. Therefore, from the information provided, it is evident that an effort towards safety program is vitally needed at construction sites. Management commitment, safe working condition and safe work habits are all what are needed for effective implementation of safety program.

Keywords: *Construction sector, construction accident, workplace, contribution, safety program*

1.0 Introduction

Construction Sector is one of the largest sectors in many parts of the world and has been regarded as the most dangerous and hazardous workplace, due to the types and nature of the activities that is taking place in the construction sites, as construction workers come in contact with dangerous equipment and substances which can easily affect their physical and health condition.

A construction employment statistic compiled by construction industry development board revealed that construction workers constitute about 7.1% of total workforce in Malaysia (DOSH, 2010). The industry generally accounts for 11% of all industrial workers fatalities (DOSH, 2007). In year 2010, Occupational accident in the Malaysia construction sector alone includes 66 death, 4 cases of permanent disability and 50 cases of non-permanent disability (DOSH, 2011). Moreover, according to CBS Interactive

Business Network 2007, since 2001, the Malaysia construction scene has consistently recorded fatality rate of over 25% per 100,000 workers,(CIDB, 2007).

Accidents at workplace happen most often to male workers, a study conducted by (Murty *et al.*, 2006), reveal that construction sector is a male dominated occupation. Figure 1 shows the result of the study carried out for a period of 1996 – 2005 and the data were obtained from the pathology unit of the University of Malaya. From figure 1, male accident accounted for 96.5% (221), while female accident accounted for just 3.5% (8).

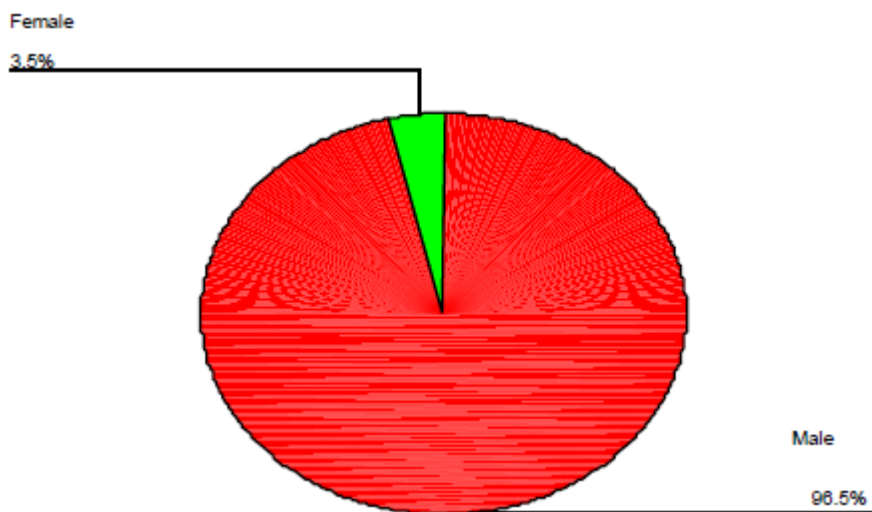


Figure 1: Accident According to Gender. (Male, 221; Female 8 cases.)

Race is also an important explanatory factor, Malaysia construction sector is dominated by migrant workers and are over – represented in accident statistic. Table 1 shows some selected accident cases in Malaysia construction sector as at December 2011 obtained from Department of Occupational Safety and Health. Migrant workers from Bangladesh, Indonesia, Pakistan etc, are mostly involved in the accidents.

Table 1: Some selected accident cases in Malaysia as at December 2010 (DOSH , 2011)

S/NO	DATE	CASE TITLE	LOCATION	SUMMARY OF ACCIDENT	CLASSIFICATION.
1	29/4/2010	Killed by tractor on commuting to workplace.	Serdang, Kedah	AzlinBtAriffin 28years from Bangladesh was killed in accident during on the way to workplace.	Fatal
2	21/3/2010	Found death in confined space.	Beauford, Sabah	Wahab(30yrs),Ajin (20yrs), Mus(25yrs), Armuji(18yrs),Anur (17yrs), Danbansai(17yrs), were killed in a confined space(treated water pumping tank) they were killed due to toxic gases.	Fatal
3	21/1/2010	Killed by standing calibrator machine.	Simpong Rengam industries estate,Johor.	Abdul hossain 35yrs from Bangladesh was killed after hit by the standing calibrator door, which is not properly closed.	Fatal.
4	4/4/2010	Falling from height	Kaulalumpur, Jalan Galloway.	Sugeng 28yrs from Indonesia was killed after felt from 24 th floor to 6 th floor during cleaning and clearing at the 24 th .	Fatal
5	24/4/2010	Hit by bulldozer	Kawasan perindustrian rembin fasa Malaka.	Mohammed Rafizsham was killed after a bulldozer toppled during clearing the workplace.	Fatal.
6	29/3/2010	Scaffold collapse.	Terengganu.	Nurulislam 37yrs from Bangladesh was killed after scaffold collapsed at a construction site.	Fatal
7	19/4/2010	Falling from height	Kuala Lumpur	Sajjad khan from Pakistan was killed after falling from height, during the incident the victim was putting 'silicon' in between the window mirror. Unfortunately he steps on the area that has no mirror installed and felt down on the skylift.	Fatal.

Though these results are important and valid, the main concern of this study is to examine the causes and types of accidents in construction sector, and also to determine the contribution of fatal and non-fatal accident to the total number of accidents for the period of 2002 – 2010. Figures 2a and 2b are occupational accident of Non-fatal accidents as at 30 December 2010 as obtained from the Department of occupational safety and health Malaysia.

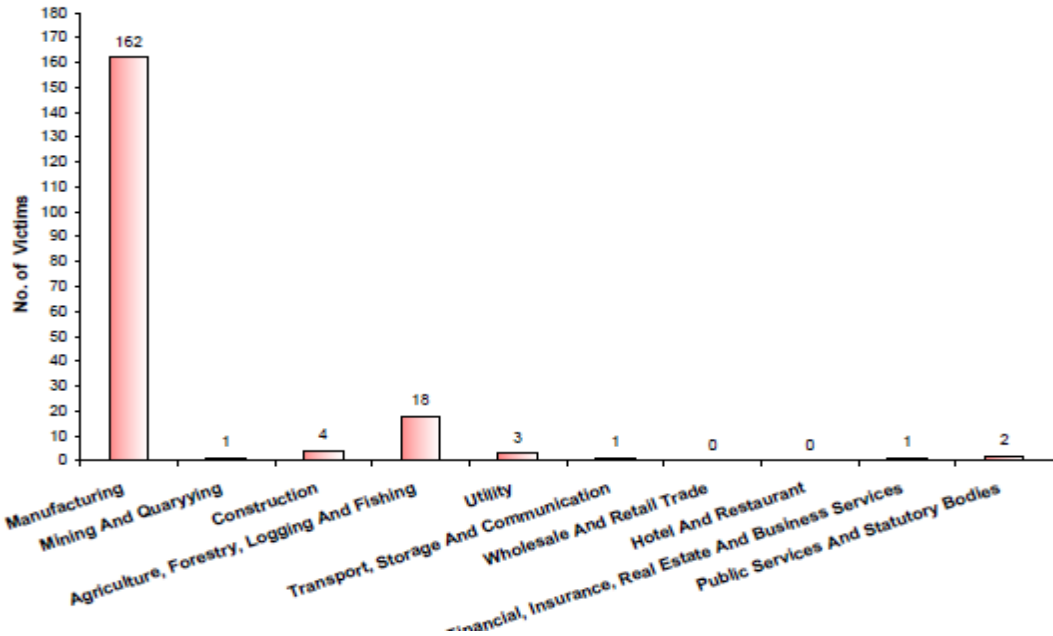


Figure 2a: Occupational accident for category of PD until December 2010 (Investigated)

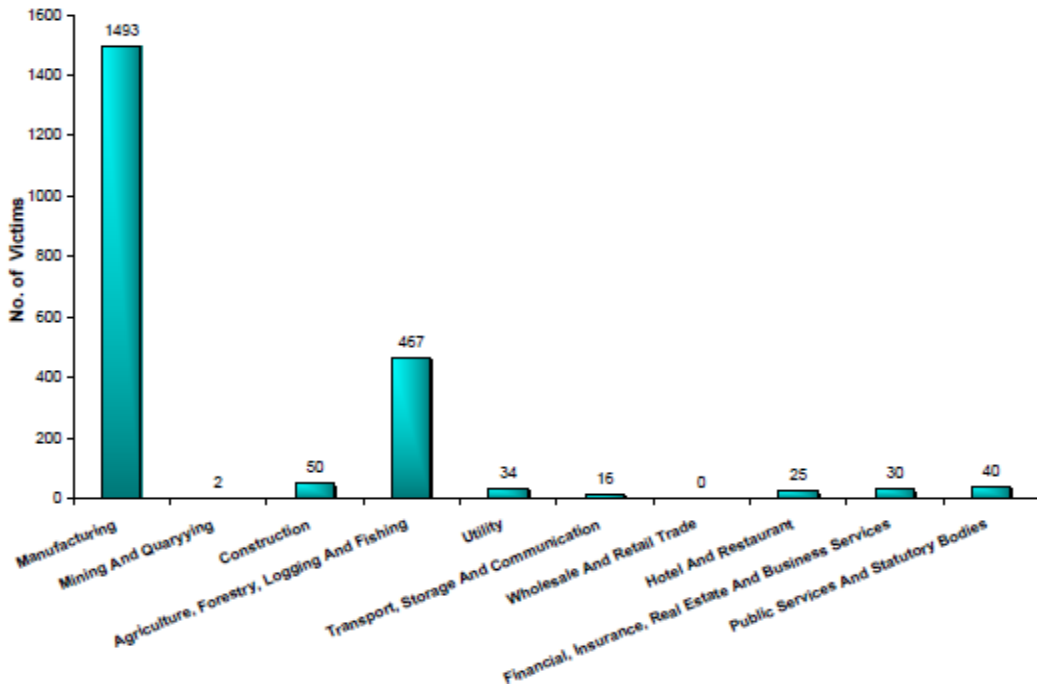


Figure 2b: Occupational accident for the category of NPD until December 2010 (Investigated).

The Non-fatal accident consists of permanent disability and non-permanent disability. From the aforementioned figures; construction sector recorded 54 cases of non-fatal accident and comes third in position to other sectors. The figures above provide information as regard to the number of non-fatal accident in Malaysia construction sector.

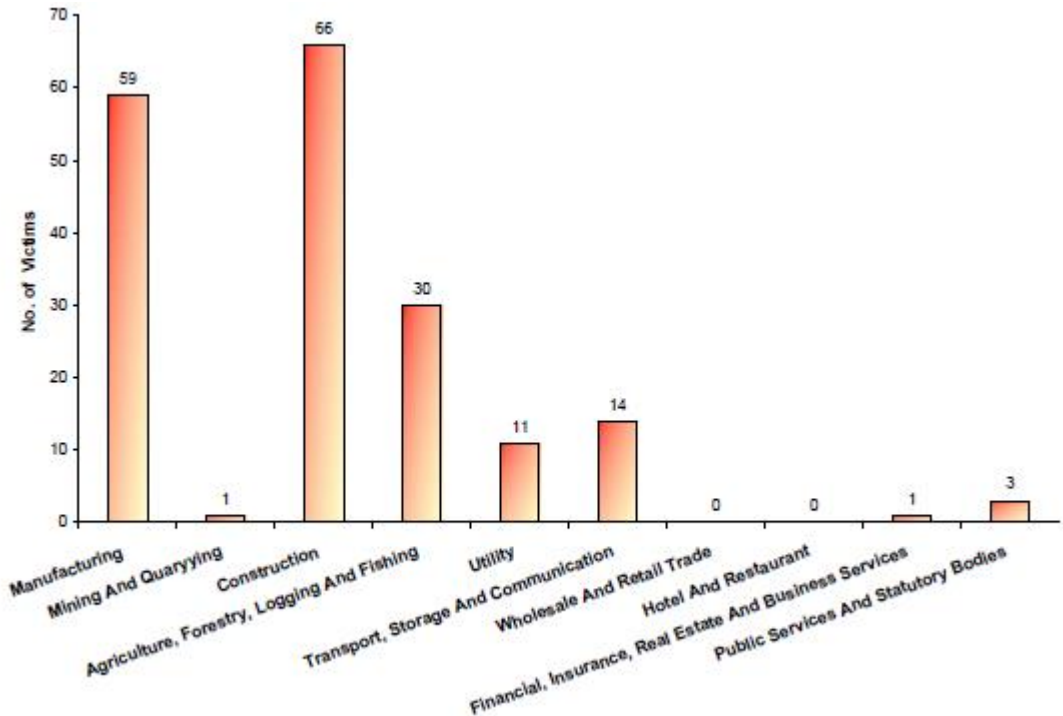


Figure 3: Occupational accident for category of Death until December 2010 (investigated).

Figure 3 shows the occupational accident by sector for the category of death. The construction sector experiences more death (fatal) when compared to others sectors. The figure also provides information as regard to the number of fatal accident in the construction sector. The root causes of accident are the behavior of individual employee and may be the primary causes of accident (Toole, 2002). Eight root courses of accident were proposed and analyses by Toole (2002) in Table 2 as follows;

Table 2: Root causes of accident (Toole, 2002)

ROOTS	DESCRIPTION	EXAMPLE.
Lack of proper training.	An employee was not properly trained in recognizing and avoiding job hazards.	A new employee is sent up to work on a sloped roof without being trained on the proper use of the fall restraint system and ties off to a deficient anchor
Deficient enforcement of safety.	An employee's supervisor (or other individual with safety oversight responsibility) knew that prescribed methods for avoiding hazards were not being followed, but neglected to enforce safety standards.	A Foreman ignores an employee who repeatedly does not use the fall restraint system provided for him/her.
Safe equipment not provided.	An employer does not provide an employee with equipment necessary to minimize hazards.	A Foreman does not provide his/her crew members with proper fall restraint systems when such systems are needed.
Unsafe methods or sequencing.	The normal sequencing of construction tasks does not occur, resulting in a task being inherently more hazardous than is typical.	A general contractor insists that a carpenter start framing before the foundation is properly backfilled.
Unsafe site conditions.	The site is inherently more hazardous than are typical construction sites.	Poor housekeeping, a broken ladder, or a structurally deficient work platform.
Not using provided safety equipment.	An employee is provided with proper safety equipment but does not use it properly or does not use it at all.	A trained and experienced tradesperson who has been provided with an appropriate fall restraint system refuses to use it.
Poor attitude toward safety.	An employee may have been properly trained, but does not properly avoid job hazards due to a "tough-guy" mentality, laziness, or a perception that prescribed methods would unduly slow job progress.	A tradesperson who has been trained on the proper use of ladders refuses to face the ladder when walking down it.
Isolated, sudden deviation from prescribed behavior.	A normally competent and safety-conscious employee suddenly and unforeseeably performs an unsafe act to fatigue, preoccupation, or likewise.	A trained and experienced tradesperson who has been using a proper fall restraint system suddenly forgets to tie himself/herself off.

The above, assumption conflict with the philosophy of some researcher/professionals that all accident is as a result of management failure, of the 8 roots proposed by Toole (2002). The first five listed are associated with unsafe condition that means a management deficiency of safety; the latter three listed are associated with unsafe act by the injured worker or injury coworkers.

A study conducted by Murty *et al.* (2006) on the courses of occupational accident in Malaysia construction industry indicated that the major courses of construction accident are; Management failure (29.2%), Unsafe method (Incorrect work procedure) (26.4%), Human element (lack of personal protective equipment and workers negligence) (12.5%), Unsafe equipment (9.7%), and Jobsite condition (11.1%).

The most commonly types of accident in construction site are; falling (22.2%), Stepping on the object (18.2%) and Strucked by falling object (17.1%). This finding coincides with latest accident data obtained from (DOSH, 2011), which indicates that falls is the major type of accident in Malaysia construction sites as shown in Table 3.

Table 3: Types of Accident in Construction industry as at 2009 as obtain from Department of Occupational safety and health (DOSH, 2011)

TYPE	FATAL ACCIDENT	NON-FATAL ACCIDENT	TOTAL ACCIDENT
Fall	34	16	50
Struck by falling object	14	12	26
Stepping on, striking against or struck by object	7	6	13
Caught in or between object	9	13	22
Overexertion to or strenuous movements	0	1	1
Exposure to or contact with extreme temperatures	1	2	3
Exposure to or contact with electric current	5	1	6
Exposure to or contact with harmful substances	11	22	33
Other type of accident N.E.C	0	2	2
Total	81	76	152

According to the Iceberg model of Henrich 1980 as cited by Salminen *et al.* (1992) called identical causation hypothesis, the authors claimed that identical causes preceded minor (non-fatal) and major (fatal) injuries. This means that the same type of accident can lead to fatal and non-fatal injuries when it happens, only when the differences in the injury variable were observed and analysed (result/outcome of the injury) so that the difference between fatal and non-fatal can be determined.

Petersen (1989) claimed that different circumstance produced major and minor injuries; example: slipping of a worker might lead to falling accident when the person is working on the scaffolds. At the saw mill, the same slipping might lead to the worker hitting his hand on the cutter making it a machine accident. However how those accidents occur at construction site is best explained by Finnish Accident Research Model (see Figure 4)

In this model as described by (Salminen *et al.*, 1992), the accident happens when the person and injuring factor hit the same place at the same place at the same time. This is called the contact event which lead to injury.

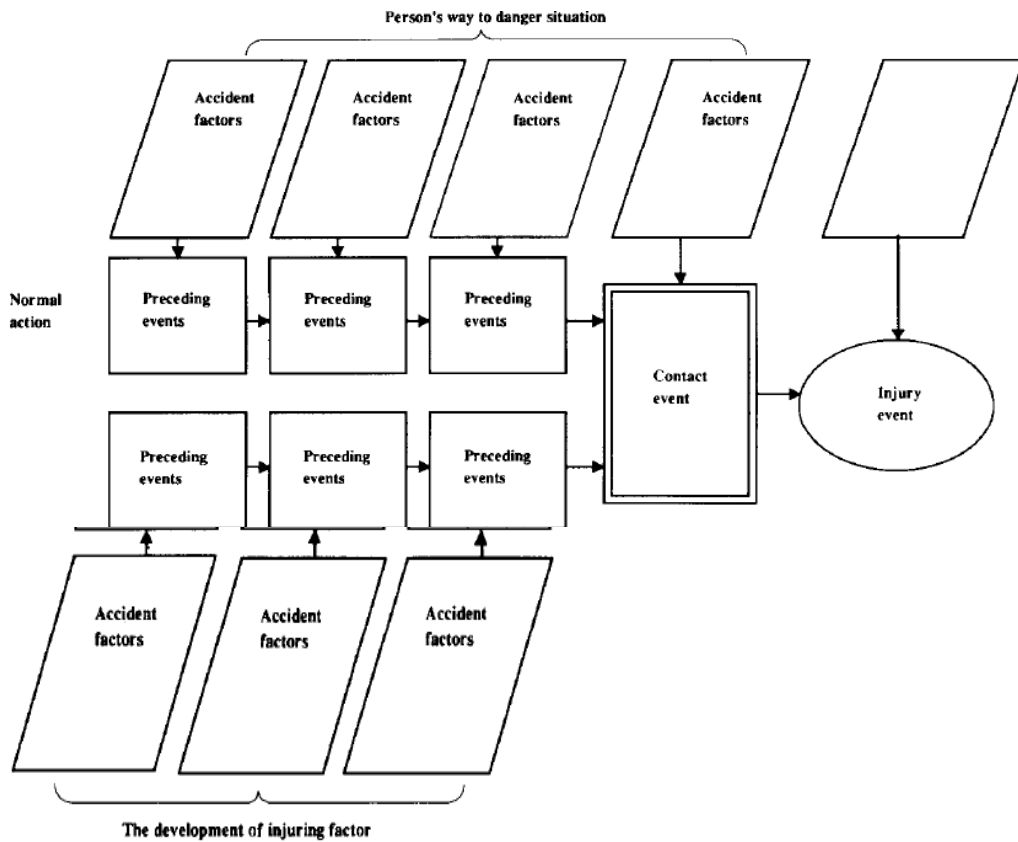


Figure 4: Finnish accident research model.

In the model as explained by (Salminen *et al.*, 1992), the person's path to danger situation and development of the injuring factor are presented as a chronological chain of event. Both the chain of event are influenced by the accident factors which are all the changes disturbance, characteristic and circumstance which have influenced event or made them possible.

2.0 Materials and Methods

The data required for this work were obtained from the Department of occupational safety and health Malaysia website, which was retrieved in February 2011. Such data consist of Number of fatal accident and Number of non-fatal accident (permanent and non-permanent disability) for the period of nine (9) years i.e 2002 to 2010.

The aim of this study is to assess the contribution of fatal and non-fatal accident to the total number of accident occurrences in Malaysia construction industry, with the following two objectives;

- 1- To examine the relationship between fatal and non-fatal accident.
- 2- To examine/determine contribution of fatal and non-fatal accident to the total number of accident during the period 2002 to 2010, using sensitivity analysis of simple linear regression.

In order to examine the relationship between fatal and non-fatal accident rates, a comparative descriptive analysis is used. Table 4 shows the rate of fatal and non-fatal accident rates as well as the total numbers of fatal and non-fatal over the period of study i.e 2002 – 2009, as obtained from Department of Occupational Safety and Health of Ministry of Human Affairs Malaysia.

Table 4: The total number of fatal and non-fatal occupational accident from 2002 to 2010 in Malaysia construction industry obtain from Department of safety and health. (DOSH, 2011)

S/no.	Year	Fatal Accident	Non-fatal Accident	Total Accident
1	2002	25	37	63
2	2003	24	34	58
3	2004	16	17	33
4	2005	63	72	135
5	2006	71	47	118
6	2007	95	86	181
7	2008	72	57	129
8	2009	81	76	157
9	2010	65	54	119

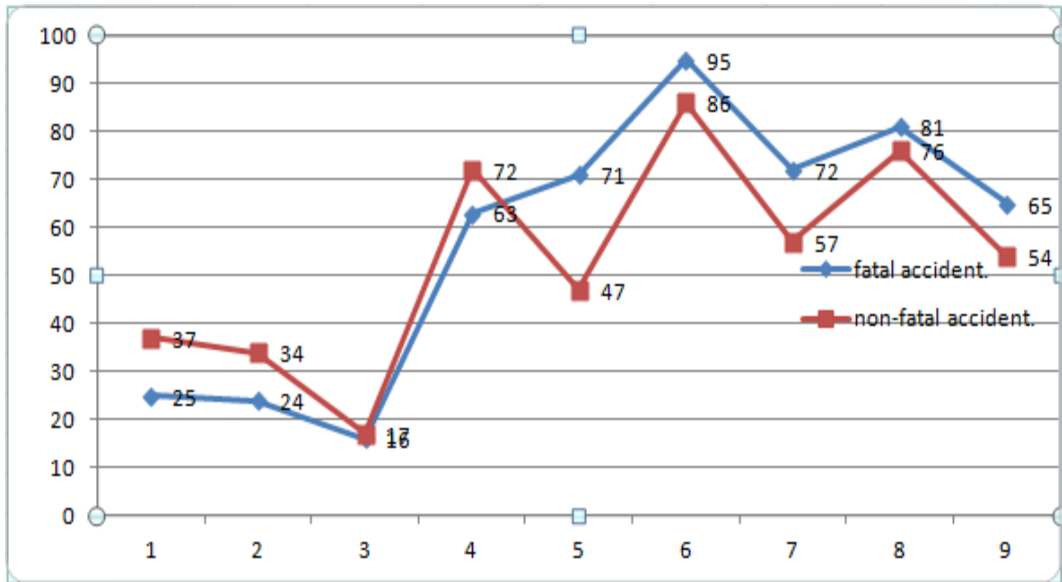


Figure 5: Total number of construction fatal/nonfatal accident from 2002 to 2009.

Figure 5 indicates that there is no clear positive or negative trend in the number of fatal and nonfatal accidents rates from 2002 – 2010, nor is there a perfect correlation between fatal and nonfatal rates. From 2002 – 2004 there have been a drop in the number of fatal and nonfatal accidents rates, this is due to the fact that only USD 3.68billion were earmark for new projects in the construction industry in the 8MP (2001 – 2005) and this include USD 263million for KLIA Infrastructure. In 2005 toward the end of the action plan the rate of the fatal and nonfatal accidents increases.

In 2006, the rates of fatal accidents increases while that of nonfatal accidents decreases and it was in this year that the Malaysia government unveiled its 9MP in which the plan strategies clearly have an impact on the construction industry meeting the housing needs and improving urban services, building basic infrastructure, improving transportation facilities etc. It was in 2007 that the construction industry experiences high rate of fatal and nonfatal accidents rates, which is due to the active implementation of the 9MP. The value of construction project in 2007 exceed RM500.000.00 which increased significantly by RM87.97 billion i.e an increase of 49.2% as compared to the total awarded in 2006 (RM58.96 billion).

Some of the projects implemented in 2007 are the Double tracking project from Ipoh to Padang Besar worth RM12.49 billion, the Double tracking project between Seremban and Gemas worth RM3.45 billion and the South Klang Valley Expressway project with value of RM1.10 million. A report on the midterm review of the Malaysia government shows that the implementation plan is on track.

In 2008, due to global financial crisis, there were no sign that the private sector will increase its investment in the near future due to the unpredictable nature of the external factors, such as the discomfort experienced in local politics and the increase in food price which had impact on household expenditure showed that there was no indicator which stimulated the demand in construction as shown in 2007 and that subsequently led to drop in number of fatal and nonfatal accident rates when compare to 2007. In 2009, the rate of fatal and nonfatal accidents rates increased more than that of 2008, that was as a result of the government response to global financial crisis in which its announced a stimulus package of RM60 billion and that package had an impact on the construction industry.

There was a drop in the number of fatal and nonfatal accidents rates in 2010, which was as a result of economic setback which affected the industry as everything was stagnated in the construction industry, as no new work done, there were lot of project that were delayed due to economic downfall. Therefore, from the comparative analysis carry out, it was observed that increases in government funding to construction increases the rates of accidents in the construction industry. To determine the actual contribution of non-fatal accidents and fatal accidents to the rate of total accidents over the period of 2002 to 2010, a sensitivity analysis of leave one is used, using simple linear regression.

Sensitivity analysis is a technique used to determine how different value of an independent variable will impact a particular variable under a given set of assumption. Also it can help in determining which of parameter (variable) is the key driver of a model results.

Table 5: Sensitivity Analysis of leave one using simple linear regression with r^2 of 0.817 for non-fatal and fatal analysis.

	<i>Rs_q</i>	<i>AR</i>	<i>Contribution to total.</i>
Fatal	0.961	0.144	53.53%.
Non-fatal	0.942	<u>0.125</u> 0.269.	46.47%.

Therefore, from the table above 53.53% of the accidents that occurred in the construction sector from the 2002 to 2010 were fatal accidents i.e deadly, while 46.47% made up non-fatal accidents. The non-fatal accident can be permanent disability or non-permanent disability. As such, fatal accident contributes more to the total number of accidents than non-fatal accident in Malaysia construction industry over the period of study.

3.0 Results and Discussions

From the analysis conducted on the available data, it was found out that there is no perfect correlation between fatal and nonfatal accidents rates over the period of study as both fatal and nonfatal accident occur more in 2007 which is due to increase in government allocation to the sector. And 2004 has the lowest accident rates owing to less allocation to the sector. Moreover, the result of the Sensitivity Analysis shows that fatal accidents (53.53%) contribute more towards accident rates than nonfatal accident (47.46%).

As such, despite the fact that there is no perfect correlation between fatal and nonfatal accidents rate, yet most accidents that occur in the construction sector over the period of study are fatal. The study was able to provide useful information as regard to the contribution that both fatal and nonfatal accident has on the total number of accidents in Malaysia construction sector and the key impact variable.

The Implication of the above finding is that it can help in successful planning of safety program at construction sites, programs that will relies on the types of accidents that occur in the construction sectors. However, according to Reese & Eidson (1999), that incidents and injuries (Accidents) on construction sites are a direct result of not adhering to their established safety procedures.

4.0 Conclusions

Construction sector is generally more hazardous than other sectors; this is based on the literature finding, which is due to the use of heavy equipment, dangerous tools, and hazardous materials all of which increase the potential for serious accidents. From the analysis carried out, it was concluded that fatal accident (53.53%) contributes more to the number of accident occurring in the construction sector while nonfatal accidents contribute 46.47%.

The findings also reveal that three (3) most commonly types of accidents in construction sites are; falling, stepping on the object and struck by falling object. The major causes of the accident are; Management failure, Unsafe Condition and Unsafe act etc. Therefore, it is evident that a focused dedication and effort toward safety program is needed at construction sites. The findings of this study affirm the importance of safety program in construction sites.

Therefore, to ensure that successful safety programs are implemented on sites, the following condition must be made;

- 1- Management Commitment; this includes leadership, vision, and direction, statement of objectives, commitment, supervision, safety analysis, and prevention planning.
- 2- Safe work condition; this includes proper housekeeping, proper site layout and space availability.
- 3- Safe work habit; this includes awareness, good communication, personal attitude, safety culture, positive groups and personal competency.

In other words, a successful safety program is based on the commitment and the participation of management and workers in policymaking and in the establishing an adequate feedback system that will lead to continuous improvement of the safety program.

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