International Review of Management and Marketing

ISSN: 2146-4405

available at http: www.econjournals.com

International Review of Management and Marketing, 2016, 6(S8) 280-285.

Special Issue for "International Conference on Applied Science and Technology (ICAST) 2016, Malaysia"

Factor Affecting Safety Performance Construction Industry

Mohd Nasrun Mohd Nawi[1]*, Siti Halipah Ibrahim[2], Rohaida Affandi[3], Nor Azalina Rosli[4], Fazlin Mohamad Basri[5]

[1]School of Technology Management and Logistic, University Utara Malaysia, Sintok, Kedah, Malaysia, [2]Department of Civil Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysian, [3]Department of Civil Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysian, [4]Department of Civil Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysian, [5]Department of Civil Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysian.
*Email: nasrun@uum.edu.my

ABSTRACT

Construction industry is undoubtedly plays a significant role in the development process of a country. However, statistics have shown that construction industry is one of the most dangerous fields due to the fatality rates. The main cause of accident is due to poor safety performance of the workers from a combination of contributing causes. In order to improve the safety performance, the root causes of construction accidents and factors affecting them are needed to be investigated. The aim of this research is to evaluate in general the current factors affecting safety performance in construction industry in order to minimize the frequency of accident occurrence. Data were obtained through literature review and distribution of questionnaires, which were analyzed by using Likert scaling method. The results indicate the most critical types of accident are fall. While the most significant factor that affects safety performance is awareness; (1) not well educated, (2) differences in age, with different level of awareness, and (3) no safety briefing/toolbox meeting. Thus, the suggestion to minimize accidents caused by poor safety performance is also by increasing the level of awareness through commitments from highest level of company by ensuring that the employees make proper use of all necessary practicable measures. Regular toolbox meeting before work commences should be practicable as it is one of the ways for information to be conveyed to the workers related to hazards or any other difficulties they faced. Apart from that, by increasing the number of safety signage to ensure that the staffs and visitors are well aware of the dangers and hazards ahead in certain situations or environments.

Keywords: Construction Industry, Accidents Prevention, Risk Control
JEL Classifications: L74, G31

1. INTRODUCTION

The construction industry is mainly considered as the most fraught with danger in related to personal safety and health. Therefore, there is a negative stereotype concerning safety in the construction industry. Occurrence of accidents and injuries can bring major losses to individuals itself, organizations and societies. From another aspect, accidents not only cause horrible human disasters but also create substantial economic losses. These financial losses are due to the impact of accidents and damages on plant equipment and workers. Moreover, there is also a loss of productive work time until the normal site working environment and morale return to the initial state. The construction workers are one of the most vulnerable members in a project and are faced with potential risks and exposure throughout the construction process. According to the Social Security Organization (SOSCO) (2001), the number of construction accidents has increased by 5.6% from 4,406 cases in 1995 to 4,654 cases in 2003. In addition, the fatality rate has increased by 58.3% from 60 cases in 1995 to 95 cases in 2003. The statistic of accidents at construction sites give us a picture that Malaysian construction industry is one of the critical sectors that need a huge and fast overhaul from the current site safety practices (Shah, M.N., Salleh, N. & Nawi, M.N.M., 2016).

This research aims to evaluate in general the current factors affecting safety performance in construction industry in order

to minimize the frequency of accident occurrence. In order to achieve the aim of the research, there are 3 objectives that have been focused as follows:

i. To identify the types of accident commonly occurred on construction site.
ii. To determine the factors affecting safety performance among the construction personnel.
iii. To propose solutions for minimizing accidents caused by low safety performance on construction site.

2. LITERATURE REVIEW

Construction workers are exposed to a wide variety of health hazards on the job. Exposure differs from trade to trade, from job to job, day by day, even by the hour. Hazard is a source or situation with a potential for harm in terms of human injury or illness health, damage to property, damage to the workplace environment, or a combination of these. The leading causes of worker deaths on construction sites are referred to as occupational safety and health administration (OSHA's) focus four. They are falls, electrocution, struck by object, and caught in or between objects. These "fatal four" were responsible for nearly three out of five (56%) construction worker deaths in 2010, BLS reports. Safety performance is the quality of safety related work. Safety related work is regarded as the efforts made to achieve safety (Nevhage and Lindahl, 2008). By measuring the safety performance in construction sites, it will lead to the capturing of perception on the factors that can influence the safety performance on construction sites. OSH is being drawn with special attention as a major issue to the construction industry. It ensures company compliance with all current health and safety legislation in relation to design, construction and facilities management.

3. METHODOLOGY

The aim and objectives of this research are achieved by using two methods as follows:

i. Literature review to achieve all the objectives.
ii. Questionnaires survey to achieve all the objectives.

Table 1: Scale index

Scale (S)	Level of agreement	Index
1	Strongly disagree	3.03≤minimum index≤3.28
2	Disagree	3.28≤minimum index≤3.53
3	Moderate	3.53≤minimum index≤3.78
4	Agree	3.78≤minimum index≤4.03
5	Strongly agree	4.03≤minimum index≤4.30

The method to analyse the questionnaires survey is Likert scaling method.

$$\text{Scale index interval} = \frac{\text{Highest min score} - \text{Lowest min score}}{\text{Total scale usage}}$$

Scale index = Lowest min score + Scale index interval

The example of Likert scaling data analysis as follows in Tables 1 and 2.

4. RESULT AND DISCUSSION

4.1. Types of Accident Commonly Occurred on Construction Site

Based on the statistics issued by the SOSCO Malaysia, the number of fatality and permanent disabilities due to fall from height accidents at the construction sites is one of the highest rates as compared to other sectors. The next item is struck by object. In findings, out of 455 cases, they reported that the two highest types of accidents in the construction industry are falls (22%) and being struck by objects (17.1%) (Hamid et al., 2008) (Table 3).

4.2. Factors Affecting Safety Performance among Construction Personnel

Based on Table 4 shown the factors that contribute to the safety performance among construction personnel under management are the inadequate Personal protective equipment (PPE) at work regulations 1992 (FMA, 1967) with the min score of 4.05 where the respondents strongly agreed. It has been observed that majority of the workers at the construction sites fail to comply with work regulations 1992 which is due to their negligence and lack of awareness on the importance of wearing adequate PPE.

The other factor which affects the safety performance that the respondents responds with agree is the lack of communication between manager and workers with min score of 3.93. Poor or lack of communication during construction can cause substandard workmanship, accidents, delays and misreporting. These in turn can cause extensive cost and time. Most of the time, the project manager is nowhere to be seen around the site area and usually will linger at the construction site for only few hours.

Lack of supervision by the supervisor in charge is one of the factors that affect the safety performance in construction industry. There is no regular supervision at least once a week. Supervisor is found as the intermediate facilitator to ensure safety practice in construction project. The good safety behavior of supervisor can

Table 2: Minimum score

Total respondent (R)=30 person		Scale (S)					Total score	Minimum score	Scale index (level of agreement)
Category: Factors affecting safety performance		1	2	3	4	5	(C)	(M)	
No	Items								
A	Management	0	0	6	9	15	129	4.30	Strongly agree
B	Safety culture	0	1	6	15	8	120	4.00	Agree
C	Behaviour	2	4	17	5	2	91	3.03	Strongly disagree
D	Awareness	1	1	6	4	18	127	4.23	Strongly agree

Table 3: Types of accident

No	Types of accident	Minimum score
A	Fall	3.98
B	Electrocution	2.73
C	Struck by object	3.58
D	Caught in or between object	3.03
Total respondent (R)=40 person		

influence on safety actions that prevent an unexpected accident. Other than that, the workers are not likely to report any incidents or accidents to the person in charge on site (Table 5).

Taking example on the recent incident that occurred at MRT construction site whereby the person in charge at the site did not report the incident earlier. Reporting incidents are considered as a legal requirement. The report informs the enforcing authorities about deaths, injuries, occupational diseases and dangerous occurrences so that they can identify where and how risks arise (RIDDOR, 2013).

The feedbacks from the respondents where they strongly agreed on the irresponsible attitude of the workers during working or handling machines and discipline issues with min scores of 3.98 and 3.85 respectively (Table 6). Many accidents happen because of the irresponsible attitudes of the workers apart from their negligence and carelessness. From direct observation, it can be seen that the carelessness, irresponsible behavior of the workers in evidently risky situations such as leaving pieces of wood with nails in walkways, working on scaffolding sustained with concrete blocks instead of assembling the scaffolding available on construction site.

In relation to alcoholic beverages, some of the workers may exhibit discipline issues where they may go for a drink after work. This condition may affect their safety performance during working the following day. Besides, such behaviour is potentially very dangerous behaviour, which has consequences of hurting other people. One of the barriers related to alcoholic worker is that the contractors do not have the authority to randomly test construction workers for alcohol or drug use although there are policies in place to take action against the workers (Knightly, 2015).

Most of the construction workers are not well educated, strongly agreed by the respondents with a min score of 3.75. The workers have hands-on skills but they lack in theoretical knowledge and applications. They do the work assigned just for the sake of doing their duty as a worker and their main concern is to execute the task given. The other factor that has been strongly agreed by the respondents with a min score of 3.63 is that differences in age, exhibit different level of awareness. Young workers often don't have the experience to recognize and avoid workplace hazards. Inexperience puts young workers at greater risk of injury, illness and death (Table 7).

The third factor which affects the safety performance with a min score of 3.58 is no or lack of safety meeting or toolbox meeting before the work commences. Usually, the workers are exposed on how important it is to have safety meeting or toolbox meeting in order to increase their level of awareness and also to put their safety as their first. While in reality, they don't apply what they have been taught or exposed to and no doubt that the safety and health takes a low priority to time discussions and budget.

4.3. Mitigative Measures for Minimizing Accidents Caused by Poor Safety Performance

The respondents strongly agreed that daily inspection by the supervisor is essential to monitor their safety performance in order to prevent accidents or near miss incident from happening with a min score of 4.23. Safety performance on sites can be improved effectively provided that safety inspection is being done regularly and it can function as a continuous improvement tool to benchmark safety at workplace (Table 8).

Apart from that, the workers need to undergo trainings under SICW/CIDB, with a min score of 4.13 that the respondents agreed. Once the construction activity increases, usually the shortage of skilled and trained people is more acute. In order to give more directive instruction as to how an act should be performing, this is where the safety training comes in handy. The act provided will be more effective and they have a clear picture on how to perform properly during working without having any fear of facing a tendency potential accident occurs (Zakaria et al., 2010).

Actively report any incidents or accidents should be a culture of the workers at the workplace. Unfortunately, in most cases, the incidents or accidents are swept under the carpet. The reasons why the workers seldom report any incidents or accidents are mainly because they are scared of the outcomes that their supervisors or the person in charge will scold them (Yilmaz, 2014). The next solution that has been agreed by the respondents with a min score of 4.40 is close supervision by safety officer and top management (Table 9).

The workers who are stubborn to use the safety equipment, to obey the work procedures, assuming that the safety is not important, always give up and get bored with certain type of works will make them loose focus and concentration in doing their works. The potential contributor towards accident is the inadequacies with supervision. There is more concentration of supervision on larger sites (Haslam et al., 2003). By doing a close supervision on the workers, the safety officer or person in charge at the site can monitor and ensure that the workers are provided with adequate PPE and aware of their responsibility to wear the PPE correctly and handling the equipment with proper care.

Lacking of safety culture may be caused by the non-compliance of the safety or OSHA's requirement. Based on Table 10, the respondents strongly agreed with a min score of 4.43 that in order to take action with regard to the workers behaviour is by engaging a serious action if workers do not comply to safety requirements or OSHA and even OSHMS. Apart from that, it has been almost two decades since OSHA 1994 was first implemented in Malaysia, there has been not much revision done on OSHA in last 5 years. It is strongly believed that much more can be achieved with concerted effort from the government, which are DOSH and CIDB on OSH.

Table 4: Factors affecting safety performance in terms of management

No	Factors affecting safety performance in terms of management	Minimum score
A	Absence of SHC	3.68
B	Fail to nominate safety officer that comply with OSHA and NIOSH regulations	3.75
C	Lack of communication between manager and commitment to OSHA 1994	3.78
D	Lack of communication between manager and workers	3.93
E	Inadequate PPE at Work Regulations 1992 (FMA 1967)	4.05
Total respondent (R)=40 person		

SCH: Safety and health committees, OSHA: Occupational safety and health administration, PPE: Personal protective equipment

Table 5: Factors affecting safety performance in terms of culture

No	Factors affecting safety performance in terms of culture	Minimum score
A	No regular supervision at least once a week	3.85
B	Difficulties in communication towards foreign workers	2.94
C	Risk assessment is not practicable at workplace	3.23
D	Workers are not likely to report incidents/ accidents	3.60
E	Decision making does not involved all organization	3.35
Total respondent (R)=40 person		

Table 6: Factors affecting safety performance in terms of behavior

No	Factors affecting safety performance in terms of behaviour	Minimum score
A	Workers under influence of drugs and alcohol	3.13
B	Discipline issues	3.85
C	Irresponsible attitude of the workers during working or handling machines	3.98
D	Fatigue caused by working overtime	3.48
E	Working for incentives	3.45
Total respondent (R)=40 person		

Table 7: Factors affecting safety performance in terms of awareness

No	Factors affecting safety performance in terms of awareness	Minimum score
A	Differences in age, with different level of awareness	3.63
B	Lack of accident records and official safety data	3.30
C	Not well educated	3.75
D	No safety briefing/toolbox meeting	3.58
E	Lack of safety signage board	2.83
Total respondent (R)=40 person		

Table 8: Solutions in terms of management

No	Solutions in terms of management	Minimum score
A	Trainings for workers under SICW/CIDB	4.13
B	Daily safety inspection by supervisor	4.23
C	Well-designed selection procedures (selection of workers)	3.85
D	Have in house technical expertise/SHO/SS	4.10
E	Demonstrate commitment to well-funded structured and well-funded programmes	3.93
Total respondent (R)=40 person		

Table 9: Solutions in terms of culture

No	Solutions in terms of culture	Minimum score
A	Close supervision by safety officer and top management	4.40
B	Decision making involved in all levels of management	4.00
C	Prohibits the work when there are potential hazard (e.g.: Storm)	4.35
D	Carried out risk assessment/ HIRAC/HSE	4.23
E	Actively report any incidents/accidents	4.55
Total respondent (R)=40 person, HSE: Health and safety		

Table 10: Solutions in terms of behaviour

No	Solutions in terms of behavaviour	Minimum score
A	Check drugs and alcohol during hiring process	4.03
B	Periodic medical checking	3.80
C	Impose drug policy to be part of disciplinary policy	3.98
D	Organizations should know how to deal with drugs/alcohol related issues	4.03
E	Serious action if workers non-compliance to safety requirements/OSHA/OSHMS	4.43
Total respondent (R)=40 person, OSHA: Occupational safety and health administration		

Table 11: Solutions in terms of awareness

No	Solutions in terms of awareness	Minimum score
A	Commitments from highest level of company	4.28
B	Regular tool box meeting before work commences	4.28
C	Annual construction industry safety award scheme	3.60
D	Take advantage of any work related HSE training that is available	3.95
E	Increase in number of safety signage	4.20
Total respondent (R)=40 person, HSE: Health and safety		

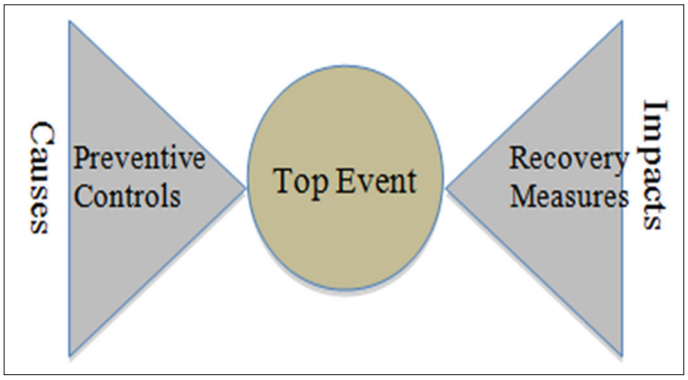
In terms of solution related to the awareness, commitments from the highest level of company and regular tool box meeting before work commences came out as strongly agree in their min response of 4.28. On the other hand, increase in the number of safety signage has shown a high min score with strongly agree of 4.20 (Table 11). Lack of safety awareness and poor thinking

Table 12: Example of bowtie flow

Hazard	Threats	Barrier	Top event	Recovery measure	Consequences
Poor safety Performance	Management Culture Behaviour Awareness	Inadequate PPE No regular supervision Attitude of workers Not well educated	Frequent occurrence of accident	Daily safety inspection by supervisor Actively report accidents Serious action for non-compliance to safety requirement Regular toolbox meeting	Fatality Reputation

PPE: Personal protective equipment

Figure 1: Bow tie diagram



of workers in safety and health issue are the main point why these accidents happened. For instance, many workers think that personal protection equipment is not necessary for those who have a lot of experience in construction site (Ramasegar, 2013).

Toolbox meeting or safety meeting is a gathering which involves all the construction workers to discuss on the health and safety matters. Toolbox meetings are a way for information to be conveyed to workers and for the workers to have their say about the hazards, incidents or accidents or anything that they are unsure with. Top management should enforce a rule whereby the workers must have a daily toolbox meeting every morning before the work commences (Bizzell, 2008). The final solution is to increase the number of safety signage available. One of the main means of communicating related to health and safety information is safety signs and signals. This includes the use of signage, acoustic signals for example the fire alarm and marking of dangerous substances (Muiruri and Mulinge, 2014).

5. DISCUSSION AND RECOMMENDATIONS

5.1. Bow Tie Method

Bowtie method is a risk evaluation method that can be used to analyse and demonstrate causal relationships in high-risk scenarios. It functions to investigate the root cause of accidents and determine the mitigative actions. Figure 1 shows the diagram that possessed a similar figure as a bowtie that comprises of the top event, preventive controls, recovery measures, causes and impacts of it.

Based on this research, the aim is to minimize the frequent accident occurrence which is fall by improving the poor safety performance. Table 12 shows how the bowtie method works. Bow tie method is a systematic approach that helps one to organise and plan proper mitigative measures for problems that arise. Therefore, the threats or the causes of such situation are due to management, culture, behaviour and awareness. By knowing the threats, barriers can be identified such as inadequate PPE, no regular supervision, attitude of the workers and not well educated. From the barriers, one can develop the recovery measure.

5.2. Safety Audit

By right, before executing any job or task, it is a good practice to do a checklist for various areas in order to monitor the work properly and take serious actions if necessary. Checklist for safety audit is required in order to know the compliance or non-compliance to OSH act and factories and machineries act and perceived to be important from the safety point of view. The outcomes will revealed how an organization is doing in maintaining a safe and healthy incident reporting and investigations and machineries and fall.

6. CONCLUSION

The research identified the types of accident and factors affecting safety performance on construction sites and suggests the approaches to minimize the number of accidents caused by low safety performance. The most significant type of accident commonly occurred is fall whereas awareness is the major problem being faced by the construction personnel that leads to poor safety performance. Therefore, by doing this research, it can be deduced that the solutions needed are also in terms of awareness. Hence, by identifying the root causes and effective prevention measures are the most significant approaches to minimize the frequency of accidents occurrence and improve the safety performance among construction personnel on construction sites.

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