A Study On Causes Of Accident And Prevention In Malaysian Construction Industry

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ABSTRACT

The construction industry is a dynamic and innovative industry that delivers building and infrastructure for all aspects of commercial and domestic activity. This dynamic and innovative industry faced with safety challenges on a project-by-project and day-by-day basis. Hence, this research objective is to identify the causes of accident happened in construction sites and measures order to improve the safety performance. Eighty sets of closed-ended questionnaire were distributed to the relevant respondents such as site manager, site safety officer, contractor, project manager and others. The results from 30 completed questionnaires form a database for the descriptive and ranking analysis on causes and also prevention of accident. The finding of this study reveals that accidents are generally causes by unsafe act and unsafe condition besides others sub causes which are indirectly cause to the accidents happen. Accidents can be result from combination of contributing causes one or more than that. The main causes of the construction accidents are the human element, poor site management, failure to use personal protective equipments and unsafe equipment used in construction works.

Keywords: Accident, Construction Projects, Malaysia, Prevention,

INTRODUCTION

Rahim (2008) defined an accident as an event that which is out off any planning, desirable, expectation or controlled. People would normally pay more attention to the accident that result in injuries (Hinze, 1997). An accident does not means that it is necessarily cause an injury but it also destroy the tools and materials. Accident is an undesired event, which results in physical injury or property damage, usually resulting from contact with a source of energy above the ability of the body or structure to withstand it. According to Ridley (1986), 99% of the accidents happen are due to either unsafe acts or unsafe conditions or both. All accidents should be of concern regardless of the nature of the loss or damage. Precaution should be taken to avoid and minimize the future accidents. The statistics from NSTP (2000) shown that the increase number of construction accidents by 5.6 percent from 4,406 cases in 1995 to 4,654 cases in 2003. In addition, the fatality rate has increased by 58.3 per cent from 60 cases in 1995 to 95 cases in 2003. The fatality rate from construction accidents are among the highest compared to the overall industry.

Therefore, this paper discussed about the causes of accident and prevention taking to minimize the risk of accident in the construction industry. Accident in construction has result in undesired injury, property damage and interruption. In order to minimize the number of accidents, there is a need to identify where and how risks arise. The rationale for conducting this study is to improve the management of safety and health in construction projects.
CAUSES OF ACCIDENTS IN CONSTRUCTION INDUSTRY

Abdelhamid and Everett (2000) conducted a study on the causes of accidents in the USA construction industry and classified them into two main factors, which are human and physical factors. According to Tam et al (2004), the causes of accidents were the poor safety awareness from top leaders, lack of training, lack of organizational commitment, lack of technical guidance, uncontrolled operation, unwillingness to input resources for safety, lack of certified skill labour, unsafe equipment, lack of first aid measures, lack of rigorous enforcement of safety regulation, lack of personal protective equipment (PPE), lack of protection in material transportation and storage, lack of teamwork spirits, shortage of safety management manual, lack of innovative technology and poor information flow.

From the studies and research that carried out by the several researchers, it could be concluded that the unsafe acts and unsafe condition are categories to immediate or primary causes of accidents, because they are the most obvious causes and are usually directly involved or present at the moment the accident happen. According to Holt (2001), secondary causes are the failures of the management system to anticipate, and include lack of training, maintenance, adequate job planning and instruction, and not having safe systems of work in place. Some of the primary and secondary causes of the accidents are discuss further as follow.

Using Defective Equipment

Using defective equipment and tools also an unsafe act since it can directly cause any injured to workers (Holt, 2001). Accidents using defective equipment occur due to it poor performance. According to Toole (2002), poor management of safety equipment acquisition and maintenance will result in more injuries.

Failure to Use Personal Protective Equipment

Working without wearing any personal protective equipment (PPE) may highly increase the probability for getting any undesired injured. According to Dorji and Hadikusumo (2006), many workers refuse to wear PPE with various reasons such as feel uncomfortable with the gears while performing their job at site and consider it as an obstacle to their work output. The International Labour Organization (1996) revealed that some of the workers felt uncomfortable while wearing any types of PPE and it indirectly decreases their work performance.

Human Factor

Drinking alcohol or taking drugs may increase workers’ unawareness and cause serious accidents. Michaud (1995) revealed that by taking any kinds of drugs or alcohol during their works will affect the capability of the decision making. Hence, they are not able to act in good way and always lead to wrong decision-making and unsafe working. Minter (2002) stated that drugs and alcohol are the root cause or contributing cause of many accidents on the job every year.

Poor Site Management

According to Holt (2001), construction site is one of the most dangerous or risky places that can present many hazards to workers when they are performing construction related tasks. The practice of housekeeping involves proper storage, use, cleanup, and disposal of the various materials used during construction. Federated (2007)
stated that poor housekeeping causes a lot impact such as wasting time, energy, and materials as well as increase fire hazards and injuries.

Lack of Commitment

In order to ensure the effectiveness of the safety policy, Holt (2001) revealed that both management and employees have to be actively involved and committed. In the research of Sawacha et al. (1999), it is found that companies with effective safety committees are more likely to take steps that improve safety performance than those without. Working with lack of concentration and commitment could cause distraction and result in an accident.

Besides that, the accidents happen in construction site also cause by working without authority, failure to warn others of danger, missing platform guardrails, inadequate fire warning systems, excessive noise, poor illumination, financial restrictions, lack of education, restricted training, poor quality control system, group attitudes, work overload, industry tradition, society attitude to risk-taking and commercial or financial pressure between contractors.

Model based on these theories are used to predict and prevent accidents. Rahim (2008) revealed that most accident occurs from a combination of several influential causes and one or more unsafe acts and unsafe condition. Several theories of accident causation have evolved that attempt to explain the occurrence of accidents. The theories are Domino theory, Multiple causation theory and Human factor theory.

Theories of Accident Causation

Several theories of accident causation have evolved that attempt to explain the occurrence of accidents. Model based on these theories are used to predict and prevent accidents.

Sequence of Events- Domino Theory

The 'Domino Theory' attributed to Heinrich (1958) is based on the theory that a chain or sequence of events can be listed in chronological order to show the events leading up to an accident. Each event may have more than one cause, i.e. multicausal. Heinrich (1958) stated that the occurrence of an injury accident invariably results from a completed sequence of factors culminating in the accident itself. Heinrich (1958) noted that there are five stages to five dominoes standing on edge in a line next to each other, so that when the first domino falls it automatically knocks down its neighbour which in turn knocks down its neighbour and so on. Removal of any one of the first four will break the sequence and so prevent the injury.

Multiple Causation Theory

Multi causality refers to the fact that there may be more than one cause to any accident. Each of these multi-causes is equivalent to the third domino in the Heinrich (1958) theory and can represent an unsafe act or condition or situation. Each of these can itself have multi-causes and the process during accident investigation of following each branch back to its root is known as ‘fault tree analysis’.

The theory of multi causation is that the contributing causes combine together in a random fashion to result in an accident. During accident investigation, there is a need to identify as many of these causes as possible. In reality, the accident model is an amalgam of both the domino and multi causality theories.
The theory of multi causality has its basis in epidemiology. Gordon (1949) points out that accidental injury could be considered with epidemiological techniques. Gordon (1949) believed that if the characteristics of the 'host' (accident victim), of the agent (the injury deliverer), and of the supporting 'environment' could be described in detail, more understanding of accident is the result of a complex and random interaction between the host, the agent and the environment.

**Human Factors Theory**

The human factors theory of accident causation attributes accidents to a chain of events ultimately caused by human error. It consists of the following three broad factors that lead to human error. The factors are overload, inappropriate response, and inappropriate activities. These factors are summarized in the Figure 1 below.

![Figure 1: Factors that cause human errors.](image)

**ACCIDENT PREVENTION**

The construction site is one of the most dangerous places. All the activities can cause different accident happened and these often result in deaths or injuries. Therefore, accident prevention should be done to decrease the rate of the accidents. Holt (2001) stated that accident prevention in construction is not just a matter of setting up a list of rules and making safety inspection, but is required to have a system for managing health and safety which meets and complies with the law. The safety measure that discussed in this paper are safety and health rules, regulation and policy, personal protective equipment, housekeeping, fire prevention and fire extinguishers, tool inspection, emergency procedures, safety bulletin board, construction safety meeting, first aid training and incident investigation.

**Safety and Health Rules, Regulations, Policies**

According to CSAO (1993), a health and safety policy is a written statement of principles and goals embodying the company's commitment to workplace health and safety. Safety policy demonstrates top management's commitment to ensure safe working environment and methods at every single construction sites. In Malaysia, The Department of Occupational Safety and Health (DOSH) and other government
agencies have regulations that set down the legal requirements to ensure the safety and health of all the workers at the place of work.

Fire Prevention or Fire Extinguishers

According to Holt (2001), there are two methods of dealing with fire in construction work; preventing it happening and controlling the consequences if it should happen. Both require equal attention during the planning process. The three ingredients of fire are fuel, oxygen and a source of ignition. By removing any one of them and there will be no fire. Much of fire prevention takes place at the planning stage, where simple rules apply:

- Use less flammable materials
- Minimum the quantity of flammables on site
- Store flammable solids, liquids and gases safely, separated from each other and from oxygen cylinders or oxidising materials.
- Make sure that rubbish is removed regularly
- Ban smoking in appropriate areas

Emergency Procedures

Gibb (2000) revealed that the most obvious emergency is fire. The safety plan should contain an appropriate emergency plan, written to cover the detailed arrangements on a project. Other potential emergency situations which may require the emergency plan include flooding and multiple injuries from any cause. A more common form of emergency is the need to evacuate an injured person especially from the most inaccessible area of the project. Emergency plan can shorten the duration taken between an injury occurring and arrival at a treatment centre. This should always be evaluated and reassessed as construction work proceeds.

Planning for emergencies begins with the purpose of minimizing their likelihood. The aim of publishing an emergency plan is to ensure that everyone on site can be alerted in an emergency, and knows the emergency signal and also the action should be taken. All the emergency routes must be identified, signed, adequately lit and kept clear. When planning emergency procedures, routes and exits, the following should be taken into account:

- Size and characteristics of the site and the work being done
- Way to raise the alarm under those conditions
- Plant and equipment being used in site
- Quantity of people are likely to be present (size of the exits)
- Properties of substances likely to be present
- Location of the nearest emergency services and their capabilities
- Access to the site for emergency services

Safety Bulletin Board

According to the Washington State Dept. of Labor and Industries, the purpose of the safety bulletin board is to increase employee’s safety awareness and pass on the company’s message. It is the place where the employer communicates policies and procedures to employees. Most of the latest information will be displaying on this board. Therefore, it is an effective way to communicate information among employees and employers. An attractive bulletin board can help promote safety in the workplace.
Safety information and policies and procedures that posted on the bulletin board provide a continuous point of reference that employees come to depend on.

Construction Safety Meeting

Cheung (2005) revealed that inaugural meeting or initial work meeting should be carried out and attended by the entire professionals include the safety advisors and inspecting engineer. During the meeting, there will be a briefing on safety policy and also the details of the safety plan. Commencement of any site works only if getting approval from the inspecting engineer. Besides that, safety manager and safety officer are appointed as required by the contract. Approval of the appointment of the safety staff was also required from the inspecting engineer.

Incident Investigation

Petersen (1978) revealed that the investigation of accident is the most difficulty in accident prevention. There should be a defined procedure for investigating all accidents. Checklist and format form are use in collecting and record all the important details. Normally, the management team of the project will be involved. They will be the people who involved in the investigation and also reporting the procedure for less serious accidents. Workers’ representatives may also be involved as part of the investigating team. The following are essential tools used during the investigation of accidents:

- Report form, possibly a checklist as a routine prompt for basic questions
- Notebook or pad of paper
- Tape recorder for on-site comments or to assist in interviews
  Camera — Polaroid instant-picture cameras are useful
  Measuring tape, which should be long enough and robust
- Special equipment in relation to the particular investigation, e.g. meters, plans, video recorder

From the viewpoint of prevention, the purpose of the investigation and report is to establish whether a recurrence can be prevented or it effects lessened, by the introduction of safeguards, procedures, training and information.

Personal Protective Equipment (PPE)

There are several types of PPE and each of them have its different functions, which including hearing protection, eye protection, respiratory protection, protection of the skin, and general protection in the form of protective clothing, and safety helmets, harnesses and lifelines. According to Holt (2001), personal protective equipment (PPE) has limitation. It does not eliminate a hazard if the PPE fails and the failure is not detected. Therefore, the equipment must be selected appropriately and accordingly to its use and its condition has to be monitored. Workers are required to be trained before using any types of the safety equipment.

Housekeeping

According to Federated (2007), good housekeeping in any construction site is a vital function that can improve overall safety performance by reducing the accidents from happen. A good housekeeping program should be well planned and coordinated as well as regularly practice. This is a continuous process which involved in everyone in workplace. Many accidents are credited to the other causes, such as tripping or slipping which are actually results of unsafe condition due to the poor housekeeping.
Good housekeeping is the essential to a safe working place. Therefore, some consideration should be made in order to create a successful housekeeping program.

Tool Inspection

Cheung (2005) states that safety inspection were conducted on weekly and also daily to ensure the all the devices and equipments are well functioning and are in the good condition. According to the guidelines that been established by the OHS regulation (2001) inspection and testing should be done by qualified person. All the equipments and machinery have to be completely inspected before come into operation such as personal protective equipment (PPE), hand tools and portable tools and equipment.

First Aid Training, Equipment and Procedures

According to OHS regulation (2001), first aid is important and required in every workplace. First aid provides the initial and immediate help to a person who suffering an injury and also prevent the injury from become worse. Employers are required to provide a first aid station where it is accessible at all the time in the workplace. Training generally includes the mandatory topic such as emergency scene management, severe bleeding and rescuer CPR.

RESEARCH METHODOLOGY

The research is conducted in four stages which include research proposal, literature review, data collection and processing and the last stage conclusion. Two types of data are collected in this research, which are primary data and secondary data. Primary data is obtained from questionnaire survey while secondary data obtain from published materials such as books, journal, and internet resources. Topic selection is done in early stage and problem related to the respective research area is identified. In this study, the problem statement that had been identified is the increasing of the construction accidents. Literature review is the secondary data that can be getting from the published books, articles, journals as well as online resources. The literature review provides information and also the definition in the research. Since this research is done through quantitative approach, the questionnaire is design to be the most suitable method in data collection. There are 80 sets of closed-ended questionnaire sent out to obtain the primary data. Then, the data is analysis by using the Statistical Package for the social science (SPSS) software. Last but not least, findings from the research were concluded and future recommendations are suggested at the final stage.

DATA ANALYSIS AND DISCUSSION

All of the data that collected from the questionnaire survey are formulated and analysis by using the SPSS software. Generally, mean score is used to rank the variables of the causes of accidents and the safety measure in this research. Table 1 shows the Ranking of variables causes that affect the occurrence of accident while Table 2 shows the ranking of the variables of the accident prevention.
Table 1: Ranking of variables causes that affect the occurrence of accident.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Variables</th>
<th>Mean, (n=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Human factor</td>
<td>4.50</td>
</tr>
<tr>
<td>2</td>
<td>Poor site management</td>
<td>4.50</td>
</tr>
<tr>
<td>3</td>
<td>Failure to use PPE</td>
<td>4.43</td>
</tr>
<tr>
<td>4</td>
<td>Unsafe equipment</td>
<td>4.30</td>
</tr>
<tr>
<td>5</td>
<td>Poor quality control system</td>
<td>4.23</td>
</tr>
<tr>
<td>6</td>
<td>Lack of commitment</td>
<td>4.03</td>
</tr>
<tr>
<td>7</td>
<td>Lack of education</td>
<td>3.90</td>
</tr>
<tr>
<td>8</td>
<td>Commercial pressure between contractor</td>
<td>3.83</td>
</tr>
<tr>
<td>9</td>
<td>Working without authority</td>
<td>3.80</td>
</tr>
<tr>
<td>10</td>
<td>Missing platform guardrails</td>
<td>3.77</td>
</tr>
<tr>
<td>11</td>
<td>Restricted training</td>
<td>3.73</td>
</tr>
<tr>
<td>12</td>
<td>Work overload</td>
<td>3.67</td>
</tr>
<tr>
<td>13</td>
<td>Financial restrictions</td>
<td>3.67</td>
</tr>
<tr>
<td>14</td>
<td>Group attitudes</td>
<td>3.60</td>
</tr>
<tr>
<td>15</td>
<td>Failure to warn others of danger</td>
<td>3.40</td>
</tr>
<tr>
<td>16</td>
<td>Society attitudes to risk-taking</td>
<td>3.20</td>
</tr>
<tr>
<td>17</td>
<td>Inadequate fire warning system</td>
<td>3.13</td>
</tr>
<tr>
<td>18</td>
<td>Industry tradition</td>
<td>3.10</td>
</tr>
<tr>
<td>19</td>
<td>Poor illumination</td>
<td>2.67</td>
</tr>
<tr>
<td>20</td>
<td>Excessive noise</td>
<td>2.60</td>
</tr>
</tbody>
</table>

Table 2: Ranking of the variables of accident prevention

<table>
<thead>
<tr>
<th>Rank</th>
<th>Variables</th>
<th>Mean, (n=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Personal protective equipment</td>
<td>4.73</td>
</tr>
<tr>
<td>2</td>
<td>Tool inspection</td>
<td>4.60</td>
</tr>
<tr>
<td>3</td>
<td>Safety and health rules, regulations and policy</td>
<td>4.57</td>
</tr>
<tr>
<td>4</td>
<td>Housekeeping</td>
<td>4.50</td>
</tr>
<tr>
<td>5</td>
<td>First aid training, equipment and procedures</td>
<td>4.30</td>
</tr>
<tr>
<td>6</td>
<td>Incident investigation</td>
<td>4.13</td>
</tr>
<tr>
<td>7</td>
<td>Emergency procedures</td>
<td>3.77</td>
</tr>
<tr>
<td>8</td>
<td>Construction safety meeting</td>
<td>3.67</td>
</tr>
<tr>
<td>9</td>
<td>Safety bulletin board</td>
<td>3.60</td>
</tr>
<tr>
<td>10</td>
<td>Fire prevention/ fire extinguishers</td>
<td>3.50</td>
</tr>
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</table>

From the data that been collected, most of the respondent indicates that the causes of the accident are most properly due to human element factors and poor site management. There are in the same as well as the highest rank among those causes. Then, it is follow consequently by failure to use or wear PPE, used unsafe equipment, poor quality control system, lack of commitment and education. The ranking shows that accidents in the construction site are more related to primary cause. The human element factor (unsafe act) and poor site management (unsafe condition) are categorized as primary causes. According to Holt (2001), primary causes are directly involved and present when accidents happen. Nevertheless, secondary causes such
as poor quality control system and lack of commitment and education also contributed to the occurrence of accident.

Based on Table 2, the personal protective equipment plays very important roles in accident prevention. This means that accident can be reduce and minimize to the lowest rate by using the PPE during construction works. PPE provided protection in the form of protective clothing, helmets, harnesses and also lifeline. Regularly tools inspection can help to improve the safety at construction site by avoiding the workers to use defective machinery and equipment. Workers may cause in injury when they used the equipment which are not well performing.

CONCLUSIONS

From the result, it shown that most of the accidents happened is due to unsafe act and unsafe condition which are human element, poor site management and failure to used PPE. Moreover, management system and social pressures also indirectly cause accidents happen. Both of them are categorized as secondary causes. There is several safety measure used in order to reduce or minimize the rate of the accident happened. Personal protective equipment is most commonly safety measure used to prevent injury from the accidents. Other safety measures identified in this study are tool inspection, safety and health rules, regulations and policy, housekeeping, first aid training, equipment and procedures, incident investigation, emergency procedures, construction safety meeting, safety bulletin board and fire extinguishers.

Safety measure is the method used to improve the safety performance at any workplace. Effective safety measure can result in decreasing of rate of the accidents happen. This research found that the frequencies of the accidents that present at most of the selected project are less than 5 cases. In conclusion, the safety measure used in the site will directly affect the safety performance in every single construction project.

REFERENCES

for clients and inspecting engineers.


