JOB HAZARD ANALYSIS IN THE CONSTRUCTION SITE

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CIVIL ENGINEERING
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Dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Engineering (Hons)
(Civil Engineering)

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
Civil Engineering Programme
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Approved by,

(Dr. Mohd. Faris Khamidi)

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

ONG SEANG YIK

ABSTRACT

The rapid growth of construction sector in Malaysia and the alarming number of fatalities over the years have put higher priority to the occupational health and safety. This project studies the important/benefits, needs and effectiveness of hazard and risk analysis in the construction site. A survey will be conducted with respective organization or person involved in the construction industry. This report will discuss on how and what type of survey methodology to be used. The outcome of the survey will cover about the people awareness of health and safety, the benefits and effectiveness of implementing hazard analysis in reducing the numbers of accident and fatalities at the construction site. The survey will also cover the opinion and suggestions on improving the methodology of hazard analysis and its implementation at the construction site.

ACKNOWLEDGEMENT

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CHAPTER ONE

INTRODUCTION

1.1 Problem Statement

The construction industry plays an important role in nation rapid economy growth. It has a significant role in providing strong economic push to other construction related manufacturing industries. Despite the role, the industry has long been saddled with poor image because of its high number of injuries and fatalities. It has the highest rate of fatalities per 100000 workers compare to other industries in the country. To arrest the problems, the government has establish various organization such as Department of Occupational Safety and Health (DOSH) and Construction Industry Development Board (CIDB). Till recently, there is more awareness on focusing on the upstream activities such as designing and planning for safety before certain task and work is commence at the site. Such activities are hazard and risk analysis that identified the entire possible hazard on the task involved. The analysis prioritizes on the level of hazard and the type of controlling measure to be used. Such analysis is useful in reducing the number of accidents and fatalities and it is both cost and time effective. There is a concern that although the company has conducted hazard analysis, they may not implement it effectively. Therefore, there is a need to create awareness on the important of design for safety or hazard analysis in the construction site.

1.2 Objective

To survey the importance and benefits of hazard analysis in the construction industry in reducing the number of accident and fatalities.

To survey the safety and hazard analysis implementation at the construction site in reducing the number of accidents and fatalities.

1.3 Scope of Study

This project will cover the study of role safety and hazard and risk analysis in the construction site. The study will provide a detail description of hazard and risk analysis which will cover the definition, requirements and procedures of conducting a hazard and risk analysis. This is done through the literature review on journal papers, references books, and company's guidelines, browsing through the related website, etc.

This project will cover a survey-research type methodology to look for opinion from the various construction related organization regarding the effectiveness and benefits on implementing hazard analysis in reducing the number of accident and fatalities in the construction site.

CHAPTER TWO

LITERATURE REVIEW AND THEORY

2.1 Construction Industry in Malaysia

The building and construction industry is a dynamic and hazardous industry due to diverse and complex nature of work tasks, trades and environments, as well as the temporary transitory nature of construction workplaces in the construction workforce.[2] In Malaysia, there are two types of construction works, one is the general construction such as residential construction, non-residential construction and civil engineering works while the other are special trade works such as activities of metal works, electrical works, plumbing, sewerage and sanitary works, refrigeration and air-conditioning works and architectural works which comprises of painting, carpentry, tiling, brickworks, flooring and glass works.[1] According to the source from the ministry of finance Malaysia, we are experiencing significant economic growth at an average rate of 13.5% of GDP (Gross Domestic Products) per annum from 1993 to 1997 period. This high economic growth rate gives a positive impact on the growth of construction industry during the period.[1] This rapid growth in the other case brings an increase of injuries and fatalities in the industry due to lack of attention given in occupational safety and health. [1] The construction industry plays a significant important role in the Malaysian's economy by contributing about slightly less than 5% of the GDP.[3] Despite only 5% of the GDP, construction sector provide strong economic growth push because it has extensive linkages with the rest of the economy such as construction related manufacturing industries, for example; basic metal products and electrical machinery.[1, 3] this can be proved in 1998 when construction industry was hard hit by the downturn of the economy, basic metal industries incurred some 35.6% drop in output. [3] In year 2006, Malaysia records a total of 909000 of employment in the construction industry and these accounts to around 9% of the total employment of 10275000 people.[4] Despite the importance to the nation's economy, the industry has poor image due the high number of accidents and fatalities.[1] To address the industry's welfare and safety record, CIDB (Construction Industry Development Board) with the stakeholders has developed the

Construction Industry Master Plan (CIMP) to identified a number of policies, one of which to reduce the number of accidents, injuries and fatalities at construction sites.[1]

Table 2.1 Labour Force, Employment by sector (MISC 1972) 2001 – 2006, Malaysia

Year	2001	2002	2003	2004	2005	2006
S1	1416000	1425000	1408000	1453000	1470000	1504000
S2	27000	28000	30000	35000	36000	42000
S3	2184000	2069000	2131000	2023000	1989000	2083000
S4	**830000**	**905000**	**943000**	**891000**	**904000**	**909000**
S5	57000	51000	58000	58000	57000	75000
S6	468000	497000	482000	533000	545000	540000
S7	2043000	2113000	2236000	2305000	2292000	2372000
S8	574000	638000	628000	695000	706000	751000
S9	1758000	1819000	1955000	1988000	2045000	2001000
TOTAL	9357000	9543000	9870000	9980000	10045000	10275000

Note:

Employment by Sector

S1: Agriculture, Hunting, Forestry & Fishing
S2: Mining & Quarrying
S3: Manufacturing
S4: Construction
S5: Electricity, Gas & Water
S6: Transport, Storage & Communications
S7: Wholesale & Retail Trade, Repair of Motor Vehicles, Motorcycles, Personal & Household, Goods and Hotels & Restaurants.
S8: Financial Intermediation, Real Estate, Renting and Business Activities
S9: Other Services

Source: ***Economic Planning Unit, Department of Statistics Malaysia***

2.2 Safety and Health in Construction Industry

From the report in the Master Plan for Occupational Safety and Health in Construction Industry 2005-2010. It highlighted that the fast growing construction sector coupled with the rise in the number of fatalities within the sector over the last ten years has brought attention on the importance of Health and Safety by the stakeholders. If we refer to the annual report of Social Security Organization (SOCSO) by the year 2003, there are 4654 cases recorded in the construction industry which is almost 7 percent of the total of 73858 industrial accidents reported to SOSCO. From the number of cases reported in the construction industry, almost 2 percent or 95 cases resulted in death, while 12.2 percent or 566 cases resulted in permanent disabilities. The percentage is much higher if we compare to the manufacturing industry and the agricultural, forestry and fisheries industry which recorded only 0.7 percent and 0.6 percent fatalities respectively out of the their total accidents reported.[5] Currently the fatality rate of 26 per 100000 workers in year 2003 is high if we compare with the fatality rate in the developed countries such as Japan, France and the USA which is below 20 per 100000 workers.[5] With the development of the Master Plan, it is hoped that the rate of fatality can be further reduced by 30% by the year 2003 and less than 20 per 100000 workers by the year 2020.[5]

If we refer to the **table 2.2** (extracted from SOSCO Annual Report), the report shows that in the year 2000, there were 159 fatalities (the highest annual fatalities to date) out of total 4873 reported accident cases. In the year 1996 there were 5401 reported cases (the highest number of annual reported cases to date) with 116 fatalities. During the period from 1993 to 2003, a total of 1033 fatalities have been recorded in the construction industry.[1] It is to be noted that the actual number of accidents and fatalities is much higher if we take into account of those who does not subscribing to SOSCO.[1]

Table 2.2 Fatalities by Sector

Sector / Year		Construction	Agriculture, Forestry, Fisheries	Manufacturing
1999	No. of fatalities	146	132	232
	Percentage fatalities	3.1	1.0	0.6
	Fatality rate per 100000 workers	**54**	53	17
2000	No. of fatalities	159	115	282
	Percentage fatalities	3.3	1.0	0.7
	Fatality rate per 100000 workers	**57**	47	20
2001	No. of fatalities	89	75	243
	Percentage fatalities	2.0	0.6	0.7
	Fatality rate per 100000 workers	**28**	29	16
2002	No. of fatalities	88	69	214
	Percentage fatalities	1.8	0.7	0.6
	Fatality rate per 100000 workers	**25**	27	14
2003	No. of fatalities	95	40	213
	Percentage fatalities	2.0	0.6	0.7
	Fatalities rate per 100000 workers	**26**	16	13

Source: SOSCO Annual Report

(Extracted from the Master Plan for Occupational Safety and Health in Construction Industry 2005-2010)

Figure 2.1 SOSCO Annual Report Reported Construction Accidents.

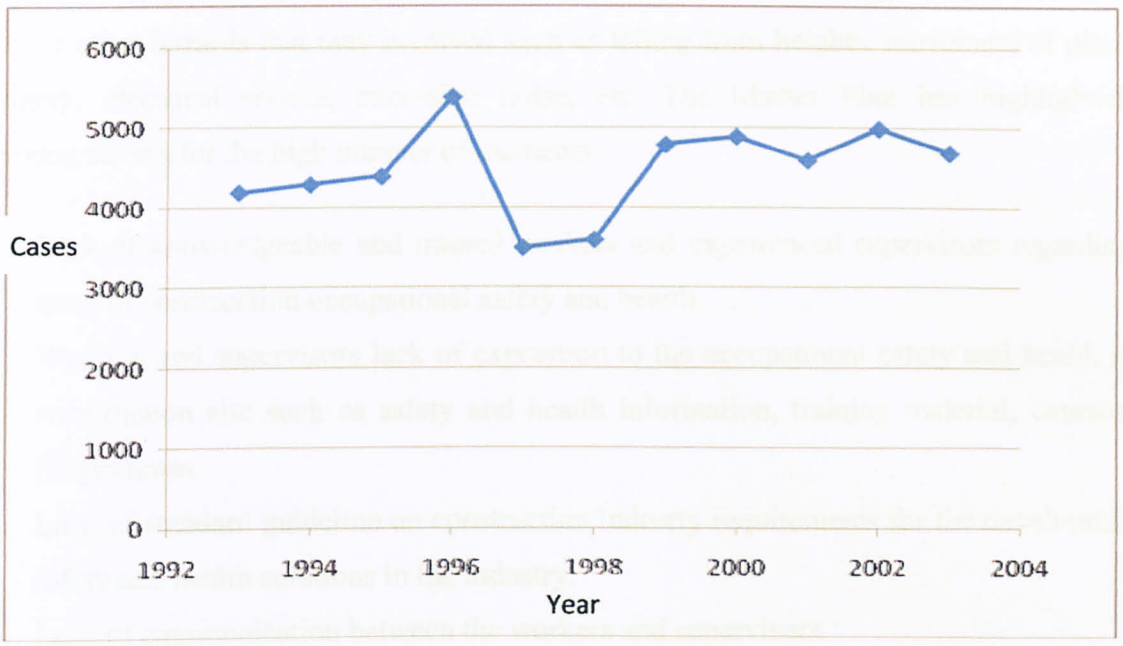
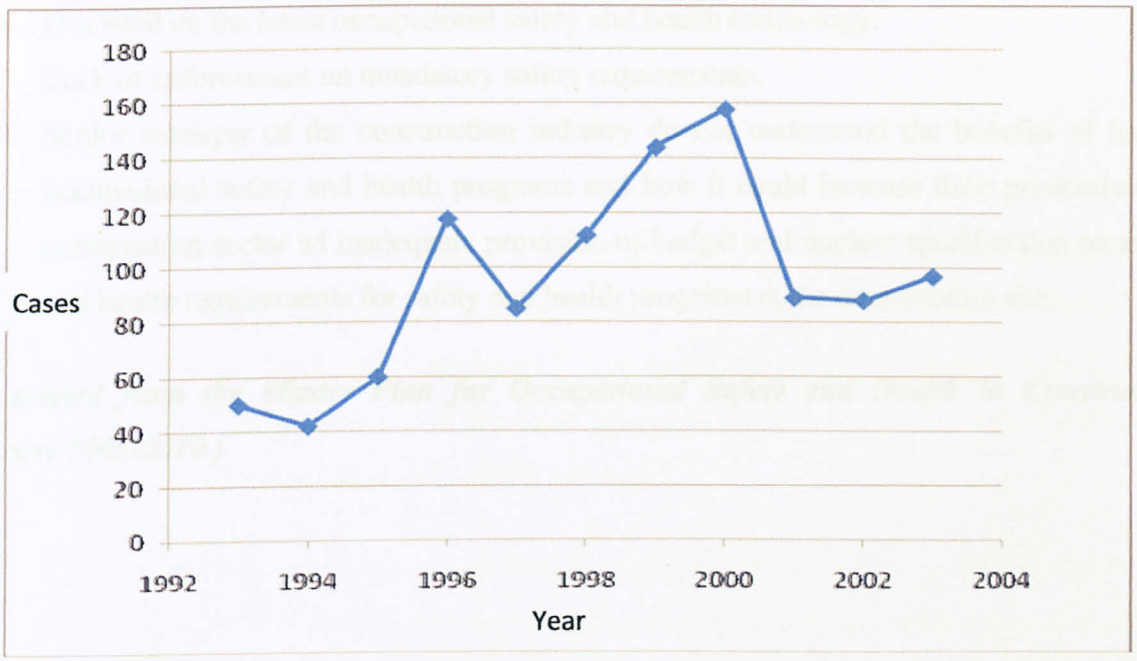


Figure 2.2 SOSCO Annual Report Reported Construction Fatalities.



(Extracted from the Master Plan for Occupational Safety and Health in Construction Industry 2005-2010)

According to the Master Plan, the high number of incidents of injuries and fatalities amongst construction workers has generally been linked to the nature of the works, weather condition and variety of other hazards that may involved such as falling from heights, movement of plant and machinery, electrical shocks, excessive noise, etc. The Master Plan has highlighted the underlying causes for the high number of incidents:

1. Lack of knowledgeable and trained workers and experienced supervisors regarding the issue of construction occupational safety and health.
2. Workers and supervisors lack of exposition to the occupational safety and health in the construction site such as safety and health information, training material, courses and programmes.
3. Lack of standard guideline on construction industry requirements for the development of safety and health solutions in the industry.
4. Lack of communication between the workers and supervisors.
5. Lack of investments and necessary expenditure to improve the occupational health and safety in the construction site.
6. Outdated on the latest occupational safety and health technology.
7. Lack of enforcement on mandatory safety requirements.
8. Senior manager of the construction industry do not understand the benefits of having occupational safety and health programs and how it could increase their productivity in construction sector ad inadequate provision of budget and unclear specification on safety and health requirements for safety and health programs at the construction site.

(Extracted from the Master Plan for Occupational Safety and Health in Construction Industry 2005-2010)

2.3 Safety and Hazard Analysis

Unfortunate construction accidents have cause excessive loss of lives and damage to property and this casting a poor image towards the industry. Many efforts have been done in the past to tackle the safety problems but most of the past efforts focused on identifying the hazards after workers arrive has commence the jobs at the site. From the experience and long historical pathway of many inconsistency and trial-and-error processes, it can be concluded that the most effective way to reduce the number of accidents and fatalities in the construction site is by removing the hazards through design of planning.[6] (David V.M) has highlighted four pioneering approaches to prevent hazards by design are to;

1. Eliminate the hazard by improving the design of the facility to be constructed and the equipment used in the task.
2. Select safer methodology if possible
3. Provide guarding to prevent contact with the hazard
4. Provide safety factors to minimize the hazard
5. Provide redundancy with several safeguards to confine the hazard.

To understand the nature of applying safer design, we need to first understand the nature of hazards.

Hazard – the inherent property or ability of something to cause harm, potential to interrupt or interfere with a process or person. Hazards may arise from interacting or influencing components. Hazard is the potential for harm.[8] A hazard is an unsafe physical condition that is always in one of the three modes: ***Dormant/Latent*** (unable to cause harm), ***Armed*** (can cause harm) and ***Active*** (causing injury, death and/or damage).[6]

Risk = chance or probability of loss, an evaluation of the potential for failure. The likelihood that harm will result in the particular situation or circumstances, coupled with a measure of the degree of severity of that harm.[8]

Risk assessment – two sense of risk assessment, first assessment made daily based on the relatively likelihood of undesirable consequences arising from the action taken in certain circumstances. Second, risk assessment based on the requirement on Health and Safety Act.[8] There are two major types of risk assessment, first the probability estimation based upon the known data of probable injuries on the circumstances being considered. Second is the probability estimation based on the generalized data on risk.[8] Risk assessment can be beneficial in the sense that we can understand better on the possible risk in order to make decisions on the most appropriate and cost effective control measures.[8]

Hazard evaluation – those associated with the hazards such as machinery, equipment, tools, procedures, tasks, process and the physical aspects of the site or premises where the work will be done are to be identified. This can be done by collecting and assemble all the information from those familiar with the possible hazard of the work. The information can be collected from the insurance companies, contractors, experiences engineer, site supervisor, special trade contractor, professional society, manufacturers, consultants and trade unions. The information can also be collected through the old record of inspection and reported accidents.[8]

Job safety/ hazard analysis – Project safety should be commence before the actual construction activities begins. Before a work activities is performed at the site, it should be examined thoroughly and hazardous task should be identified and thus control measure is adopted to ensure that the task can be performed in a safe manner.[7] In job hazard analysis, identified task is being observed and broken down into various components such as each steps or stages so that it is easier to look for existing or potential job hazards.[7] Each members of the component will be examined and derivation of control measures such as risk elimination or reductions to be identified.[8] The finding of the Job Analysis Assessment will be recorded and implemented at the site. The records of the Job Analysis Assessment must be reviewed and updated all the time. It is important that components of the task assessed to be done by involving the person who is experienced and knowledgeable in the task and those who will be doing the job in the analysis.[7,8]

Ranking hazards – there will be many task and components performed at the site. We can't possibly tackle the entire hazard identified effectively because it may be time consuming and this may cause delay to the work to be performed. Thus a ranking system on the priority for list of hazard to be controlled is performed to arrest the problem. All the components will be assessed and the probability of risk of hazard to be occurred is to be formulated. The data of probability can be collected from the past records from other construction site with similar work method. The data can also be collected from the daily observations at the site (refer table 2.3). Then, the consequences of the hazard of each component will be assessed and rated to check on its severity (refer table 2.4). A special formula is use to calculate the priority of action (refer table 2.5).

Table 2.3 Probability of hazard

Rating	Likelihood	Frequency	Description
1	Highly unlikely	About 1 in 1000 activity times	Unlikely to happen
2	Unlikely	About 1 in 100 activity times	Probably will happen but rarely
3	Likely	About 1 in 10 activity times	Could happen occasionally
4	Very likely	Frequent	Could happen frequently

Table 2.4 Consequences from the hazard

Rating	Severity	Description
5	Not harmful (Negligible)	Hazard will not result in serious injury or illness, remote possibility of damage beyond minor first aid case.[8]
10	Slightly harmful (Marginal)	Hazard can cause illness, injury or equipment damage but result would not be expected to be serious.[8]
15	Harmful (Critical)	Hazard can result in serious illness, severe injury, property and equipment damage.[8]
20	Extremely harmful (Catastrophic)	Imminent danger exists, hazard capable of causing death and illness on a wide scale.[8]

The ranking of risk can be calculated using the formula:

RISK RANKING = Probability of hazard X Consequences

Table 2.5 Priority of action from the risk of ranking

Risk ranking	Action	Timescale and Urgency
Low (5,10)	Relevant action and control measures are required and records need to be kept. Consideration need to be given for an effective solution or improvement. Monitoring is required to ensure that the controls are maintained.	Within 1 week
Medium (15,20,30)	Efforts should be made to minimize the risk. Control measures should be implemented. Where the moderate risk is associated with extremely harmful consequences, further assessment may be necessary to establish more precisely the likelihood of harm as a basic for determining the need for improved control measures.	Within 1 day
High (40,45,60,80)	Work should not commence until the control measures have been taken to minimize risk. For work in progress, take action within the same day. Work should be stopped immediately until proposed control measures has been taken satisfactorily to eliminate or minimize risk.	Immediately

(Table 2.3, Table2.4 and Table 2.5 are extracted from the Putra Perdana Construction Sdn.Bhd, "Hazard Identification & Risk Assessment Guidelines")

Controlling the risks – From the job analysis, we can identify the possible controlling measures that can be taken to reduce the number of accident and fatalities with efficiency and cost effective. There is few type of controlling measures with each have its own effectiveness.

The controlling measures by order of effectiveness:

Low

- **Personal Protective Equipment** – protecting employees and works from hazards, depends on human response, to be used as a sole measure only when all other options have been exhausted.[8]
- **Administrative Measures** – adopting suitable preventive measures (training, information such as warning signs, instructions and labels, monitoring, supervision, welfare, etc.)[9]
- **Engineering Control** – using engineering measures to minimize or reduce hazards (less dangerous construction methods, alternative designs, limiting exposure time, choice of work equipment, safe systems of work, etc.)[9]
- **Isolation** – isolating or separating the hazard or hazardous work activity or practice.[9]
- **Substitution** – substitute or replace a hazardous work activity or practice or by using a more appropriate method and equipment.[8,9]

High

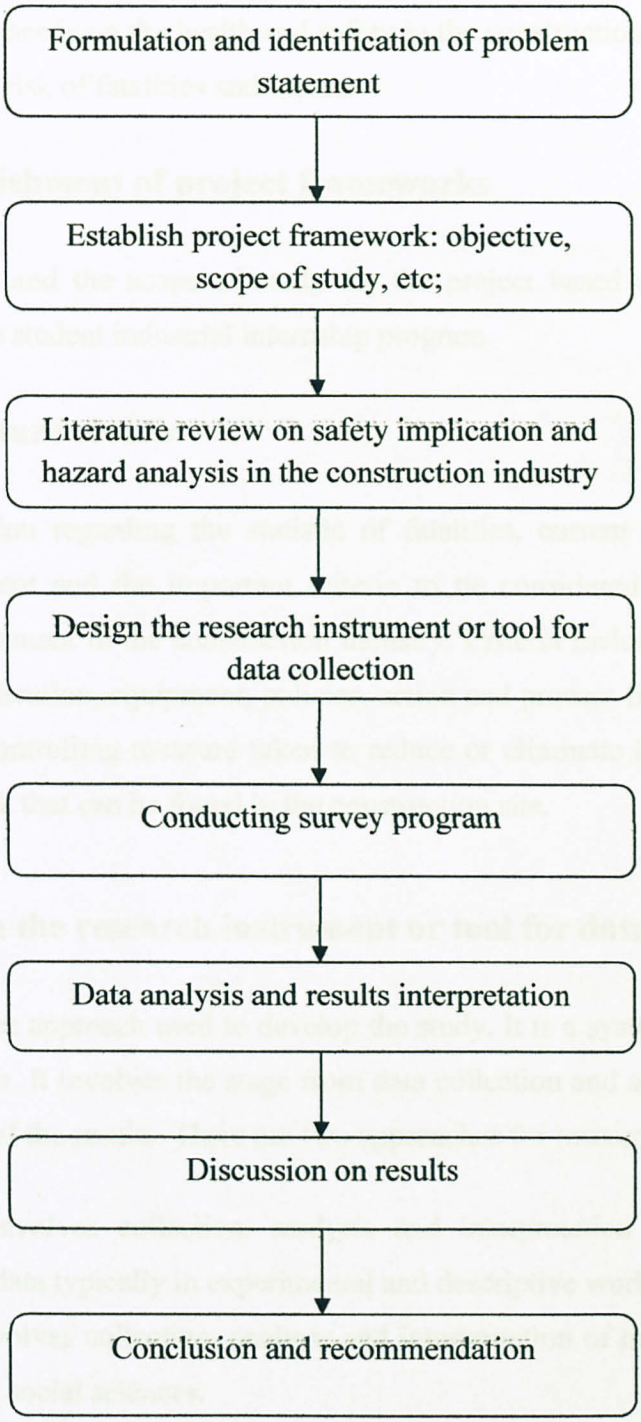
- **Elimination** – remove or eliminate the hazardous work.[8]

We need to access the job safety analysis from time to time so that the it can be effectively improve the safety and health in the construction site and thus reduce the number of accidents and fatalities. Although job safety analysis may be time consuming and involve a lot of people but it is an effective way to arrest the safety problem in the construction site. In the long run, it may cut out the unnecessary cost and lost due to the safety induced problem such as lost of property, insurance claims, medical cost, lost of productivity, output, etc.

CHAPTER THREE

METHODOLOGY

Figure 3.1 Flow chart of study



3.1 Methodology Explanation

3.1.1 Formulation and identification of problem statement

To define the risk and hazard analysis in the construction industry and identification on the problem statement and needs on the health and safety in the construction industry in Malaysia to reduce or eliminate the risk of fatalities and looses.

3.1.2 Establishment of project frameworks

To establish objective and the scope of study for the project based on own experience and observations during the student industrial internship program.

3.1.3 Literature review

Research on information regarding the statistic of fatalities, current practice of hazard and analysis, risk assessment and the important criteria to be considered to perform the hazard analysis and risk assessment in the construction industry. Criteria included the range of people, material, design consideration, equipment, policies, action and process from the beginning to the end. To identify the controlling measure taken to reduce or eliminate the risk identified in the possible hazard and risk that can be found in the construction site.

3.1.4 Design the research instrument or tool for data collection

This part focused on the approach used to develop the study. It is a system of methods and rules for conducting research. It involves the stage from data collection and analysis to interpretation, validating and testing of the results. There are two approaches for research methodology:

I. Quantitative: involves collection, analysis and interpretation of mostly quantitative (measureable) data typically in experimental and descriptive works.
II. Qualitative: involves collection, analysis and interpretation of mostly verbal typically in managerial and social sciences.

3.1.4.1 Survey Research Methodology (SRM)

The research methodology that will be adopted through this project is the Survey Research Methodology (SRM). SRM is a research methodology for getting opinion poll or for measuring people's attitude and perception. The information will be collected from the people or organization that is considered to be experienced and knowledgeable in the field of study. Survey Research Methodology is selected because it is dealing with the people who can response verbally to the study and the sampling of data and analysis are relatively simple and reliable. Typically the respondents are asked on their behaviors, attitudes, awareness, motivation and lifestyle characteristic toward the study. SRM can be in interviews or questionnaire postal type and the data are mainly verbal such as (yes, no), (strong, stronger) or (satisfied and not satisfied), etc. SRM involves wide use of statistic to draw conclusions because study only involves part of population chosen for analysis from a total of items or things considered. The accuracy of the data may depend on among how the question is posed, emotional condition of respondent, time of day/week/month/year and environment / setting and who the interviewer is.

3.1.4.2 Advantages of surveys:

I. Surveys are an effective way to collect information from a large number of respondents. Statistical techniques can be used to determine validity, reliability, and statistical significance.

II. Surveys are flexible in the sense that a wide range of information can be collected. They can be used to study attitudes, values, beliefs and past behaviors.

III. Surveys are relatively free from several types of errors because they are standardized.

IV. There is an economy in data collection due to the focus provided by standardized questions because only questions of interest to the researcher are asked, recorded, codified, and analyzed. Time and money is not spent on tangential questions.

3.1.4.3 Disadvantages of surveys:

I. The respondents may depend on subjects' motivation, honesty, memory, and ability to respond. They may not be aware of their reasons for any given action. They may not be motivated to give accurate answers; in fact, they may be motivated to give answers that present themselves in a favorable light.

II. Although the chosen survey individuals are often a random sample, errors due to non-response may exist. That is, people who choose to respond on the survey may be different from those who do not respond, thus biasing the estimates.

III. Survey question answer-choices could lead to vague data sets because at times they are relative only to a personal abstract notion concerning "strength of choice". For instance the choice "moderately agree" may mean different things to different subjects, and to anyone interpreting the data for correlation. Even yes or no answers are problematic because subjects may for instance put "no" if the choice "only once" is not available.

3.1.4.4 Types of survey

Basically there are two format of surveys namely questionnaire and interviews formats. The questionnaire is chosen as the main format to conduct the survey. Questionnaire survey is document containing set of question to be answered by the respondent. This survey is usually structured with predetermined question and selection of answer in a certain format such as YES or NO. The structure is intended to reduce bias. For example, questions should be ordered in such a way that a question does not influence the response to subsequent questions. Surveys are standardized to ensure reliability, generalizability, and validity. Every respondent will be presented with the same questions and in the same order as other respondents.

There are four types of question that can be adopted to fit in the questionnaire surveys:

I. **Contingency questions** - A question that is **answered** only if the respondent **gives** a particular response to a previous question. This avoids asking questions of people that do not apply to them (for example, asking men if they have ever been pregnant).

II. **Matrix questions** – identical response categories are assigned to multiple questions. The questions are placed one under the other, forming a matrix with response categories along the top and a list of questions down the side. This is an efficient use of page space and respondents' time.

III. **Closed ended questions** – respondents' answers are limited to a fixed set of responses. Most scales are closed ended. Other types of closed ended questions include:

- Yes/no questions – the respondent with a "yes" or a "no"
- Multiple choice – the respondent has several option from which to choose.
- Scaled questions – response are graded on a continuum (example: rate the effectiveness of hazard analysis implication in reducing accidents).

IV. Open ended questions – No options or predefined categories are suggested. The respondent supplies their own answer without being constrained by a fixed set of possible responses.

The surveys will consist of three main sections:

I. **Section A** – this section is to identify the respondent's background information such as the class of contractor, name of the project, designation and year of experience in the subject of study.

II. **Section B** – this section is the series and set of question to find the answer for the subject of study.

III. **Section C** – this section is to seek additional information and opinion regarding research

IV. **Section D** – state of appreciation and seek for preferred date of return of result if it is required

3.1.5 Conducting surveys

I. **Preparing cover letter** – need to be included with the questionnaire surveys. The purpose is to verify the validity of surveys and to provide respondents with information regarding the surveys such as objective, importance and benefits of the surveys. The cover letter need to be verified by the authority of the university such as the supervisor or dean of faculty.

II. **Pilot survey** – sending several sample of questionnaire to friends and lecturers to if there is other variables not covered that need to be included. Feedback and comment to further improve the efficiency of surveys will be collected and analyze.

III. **Sampling of data** – sample selection is critical to the validity of the information that represents the populations that are being studied. The approach of the sampling helps to determine the focus of the study and allows better acceptance of the generalizations that are being made. Here the non-probability sampling approach is chosen, the population sampling target will be the contractor of class A to class F. A total number of surveys will be send out the contractors companies and the respondents of this surveys will be focused on Developer / investors, Project Manager / Head of Project, Structural / Civil Engineers, Architect, Safety Officer and Site Supervisor / Site Coordinators.

IV. **Modes of surveys** – the main mode of survey will be by sending email to the respondents. Other modes that can be conducted will be by telephone and on site-interview

3.1.6 Data analysis and results presentation

The respondent's data of surveys will be collected and tabulated on pie-chart, histograms or by other mean of presentation such as excel. The minimum respondents data required are 30. The data will be analyzed using the statistical analysis. We can conduct the descriptive statistics on sample for question with numerical data to find the appropriate measure for central tendency such as mean, mode, median, standard deviation and frequencies. We can also carry out inferential statistical analysis to conclude about the whole population.

3.1.7 Discussion on results

The results and finding from the data collected will be analyze and discussed. From the respondent's surveys, we will discuss about the issue regarding safety and hazard analysis implication at the construction site. Here, we will also discuss on the different respond and view from different class of contractor regarding the study.

3.1.8 Conclusion and recommendation

From the findings through the surveys, we can conclude on the effectiveness of implicating safety and hazard analysis in reducing the number of accident and fatalities in the construction site. Recommendation will also be made to further improve the study of implication of safety and hazard analysis in the construction site.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Result

This chapter will conclude the findings and research that has been done for this project. All the findings and the result of the research were gathered through various sources such as the Internet, reference books, and many articles related to this project. All the results have been gathered with the same methodology as explained in the previous chapter. It also included the current development for the project and the result from the portion that has been done.

The results for this project are mainly from the research-survey methodology; therefore, enhancements were embedded gradually as the project development of the questionnaire was still in progress. Before the final questionnaires are being sent out to the respondents, a pilot survey had been conducted first in order to make sure that the questionnaires are reliable and easy to understand for the respondents. This is to ensure that the questionnaire will give more conveniences rather than troubling the respondents.

4.1.1 Questionnaires

This research-survey methodology requires the minimum number of thirty respondents from the various experience people from the construction industry. The dateline for this questionnaire to be fully analyzed is by the end of February. Therefore, for this time being, the result gathered and shown in this progress report are only for the questionnaires in which to be set for the pilot survey purposes. As discussed above in chapter 3, the questionnaires have been divided into 4 parts. Each part of the questionnaires will be commented by the respondents of this pilot survey to make an improvement for a final draft of questionnaires that will be sent out to the target respondents through email or by interview.

4.1.1.1 Pilot survey analysis

A pilot survey was applied to one site supervisor; one lecturer and two students which have undergo industrial internship for 8 months in the construction site. According to the result of this pilot survey, the questions in the questionnaire will be revised for the final draft before sending to the respondents. When conducting the pilot study, all the respondents had been reviewed with the following questions:

a) How long did it take for the questionnaires to be completed?
b) Were the instructions clear?
c) Were any of the questions unclear or ambiguous?
d) General comments on the questionnaire

4.1.1.2 Analysis of Questions

Basically there is not much problem on the questionnaires because I had do some research and make references to the previous research-survey methodology final year project. The common problem that I had face when drafting the questionnaires are mainly on the grammatical error and numbers of unrelated and difficult question for the respondents. For the analysis of interview question, the result in a form of summary could be referred to Table 4.1.

Table 4.1 Analysis of questions

Questions	Findings from the pilot survey	Recommendations to be done for the questionnaires
a. How long did it take for the questionnaires to be completed? (Does it lengthy?)	Generally the questionnaire took 10-15minutes to be completed.	Reduce lengthy instruction and the number of questions. Only include related and important question.
b. Were the instructions clear? (do the respondent understand the instruction for the questionnaire)	The instruction is clear and understandable	Do some touch up on the grammatical error
c. Were any of the questions unclear or ambiguous? (Does the questions asked suitable for the respondents and survey?)	The question is understandable and clear but the question should be straighter forward toward the project objectives. Some question such as the record of fatalities of a project should not be asked because some company may reluctant to release the information.	Reconstruct the instruction and question so that it is straighter forward toward the project objectives. Eliminate the unrelated question
e. General comments on the questionnaires	Some grammatical error in the questionnaires. The structure of the question should be making shorter and clearer. Make a maximum of 3 pages of question Included the objective and introduction to the questionnaire so that respondents understand the important of this survey. There is some confusion in question 4 and 7 because the respondent is not sure on answering the question.	Grammatical error will be corrected as commented by the lecturer. The font, number of question is corrected to make a maximum of 3 pages. Objective and description on project is included into the questionnaires For question 4 and 7, a further instruction is included so that the respondent understand how to answer it

4.1.2 Questionnaires-redesign

The comments and recommendation from the pilot survey will be considered and be used to re-design the final draft of the questionnaire that is more effective and reliable so it can meet the project objective. There is some changes that had been done to the questionnaires such as by eliminating the question that does not related to the project objective, reconstruct the word structure to make the instruction clearer and adding extra information that is necessary to make the questionnaire much more relevant.

In section A, there is not much correction to be done because the instruction for the question in this section is clear and easy to understand. The only additional information added to this section is question one under the respondents category. If we refer to the first draft of questionnaire, this question consist only 6 available answers for the respondent to choose. After considering recommendation from the experience person from the construction industry, an extra slot have been added for the respondent to state their designation with the company in case they are not falling into any of the category of the answer available.

In section B, most of the question have been grammatically corrected and reconstruct so that it is easier to understand. In this section, the author has considered the suggestion of the respondents from the pilot survey to eliminate the question on the name of the project site that will be used in this survey. The question is not necessary because some contractors are reluctant to reveal the name of the project site and may leave the question unanswered. Besides that, an extra instruction is added below the question 3 so that respondent can understand how to rate the answer. After much consideration and recommendation from the pilot survey's respondent, the author has summarized and listed seven type of individual that will be rated by the respondent. Then in question 4, extra available answers have been added because some respondent may use common sense to rank the likelihood of the accident to happen. Finally in this section, an instruction had been included below the question 6 so that the respondent will rate only once for each advantage category. This to ensure that the best advantages of implementing the job hazard analysis can be analyzing.

In section C, the structure of the question is corrected to make it shorter and easier to understand. Instead of asking the respondent in question 1 on what are the problems that may occur when conducting and carrying the job hazard analysis. The question have been changed by asking the respondents to state the problems that commonly occurs when evaluating and carrying the job hazard analysis. There is no correction make to the question 2.

There is no correction needed in section D because there instruction of the question is necessary and clear.

4.1.3 Survey sample

After the final draft of the questionnaire had been constructed, the survey form are being distributed and sent out by email to the selective company. Besides that, the survey form is also being sent to senior and friends who are working in related construction industry in December 2008. More than half of the survey respondents the author has now are from the face-to-face interview he had conducted in January 2009. The author has gone to his previous industrial internship project site to interview my previous site colleagues. The respondents here are from site consultant such as engineering and architectural consultant, sub-contractors which consist of various trade works, project manager, site engineer and site supervisor and so on. The dateline for the return of all possible respondents is by the end of February so therefore no analysis is being made yet.

4.1.4 Analysis of survey sample

After the dateline, the result from the survey form will be analyzed and the graph and percentage of each question will be shown in the analysis.

4.2 Method of Data Analysis

4.2.1 Severity Index

Severity index was calculated based on the response of the survey to reflect the level of severity effect of the level of **importance** of individual's designation in the evaluation and **advantages of** implementing hazard analysis. This index was calculated as follow (Al-Hammad, 2000) :

$$\text{Severity Index (I)} = [\sum_{i=0}^{4} a_i . x_i] / [4 \sum x_i] \times 100\%$$

Where;

a_i = constant expressing the weight given to i

x_i = variable expressing the frequency of the response for i ;

I = 0,1,2,3,4 and illustrate as follow ;

x_0 = frequency of the 'less' response and corresponding to $a_0 = 4$

x_1 = frequency of the 'least' response and corresponding to $a_1 = 3$

x_2 = frequency of the 'average' response and corresponding to $a_2 = 2$

x_3 = frequency of the 'attractive' response and corresponding to $a_3 = 1$

x_4 = frequency of the 'most attractive' response and corresponding to $a_4 = 0$

The percentage of the severity index then categorized as below in order to reflect the scale of the answer of the respondents to the questionnaire.

- 0% - 20% ~ 'non-severe'
- 20% - 40% ~ 'somewhat non-severe'
- 40% - 60% ~ 'moderately severe'
- 60% - 80% ~ 'severe'
- 80% - 100% ~ 'most severe'

4.3 Data Analysis

4.3.1 Data Collection

The data was retrieved in the form of softcopy (e-mail) and on site-interview that was done during the semester break. There are total of 34 respondents who participate in the questionnaire and as shown in **Figure 4.1**, 23 respondents or 68% in total are questionnaire that are retrieved from on site-interview while 11 respondents or 32% in total are questionnaire that are retrieved from softcopy (e-mail). This survey research is within the range of the minimum 30 respondents required to conduct an accurate analysis. The methodology of onsite-interview has contributed to the success of achieving the minimum number of respondents required.

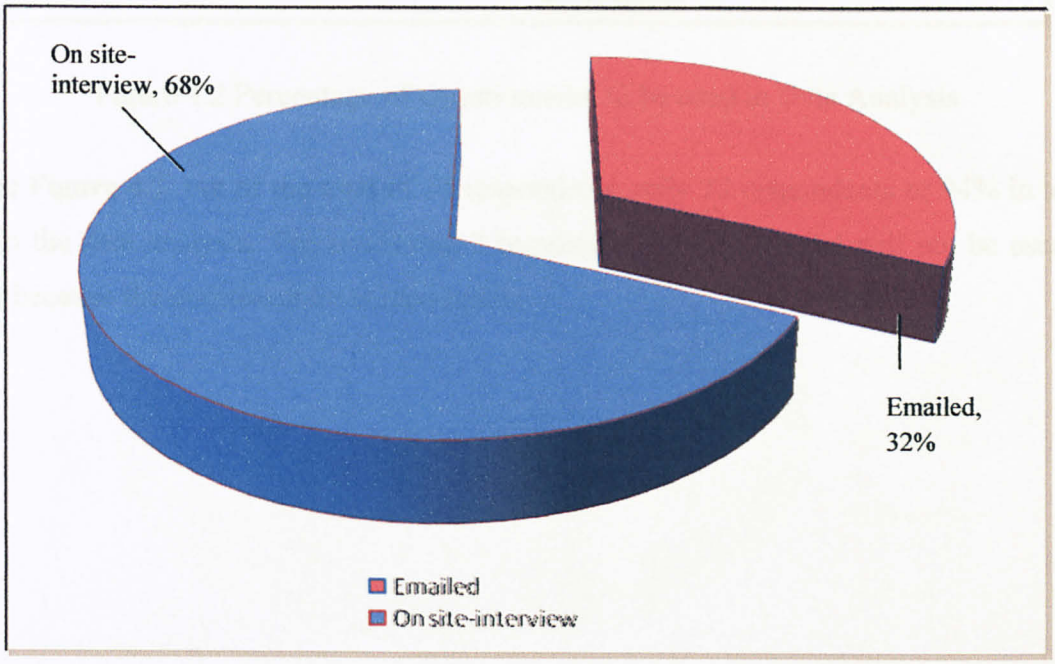


Figure 4.1 The Questionnaire's Data Retrieval

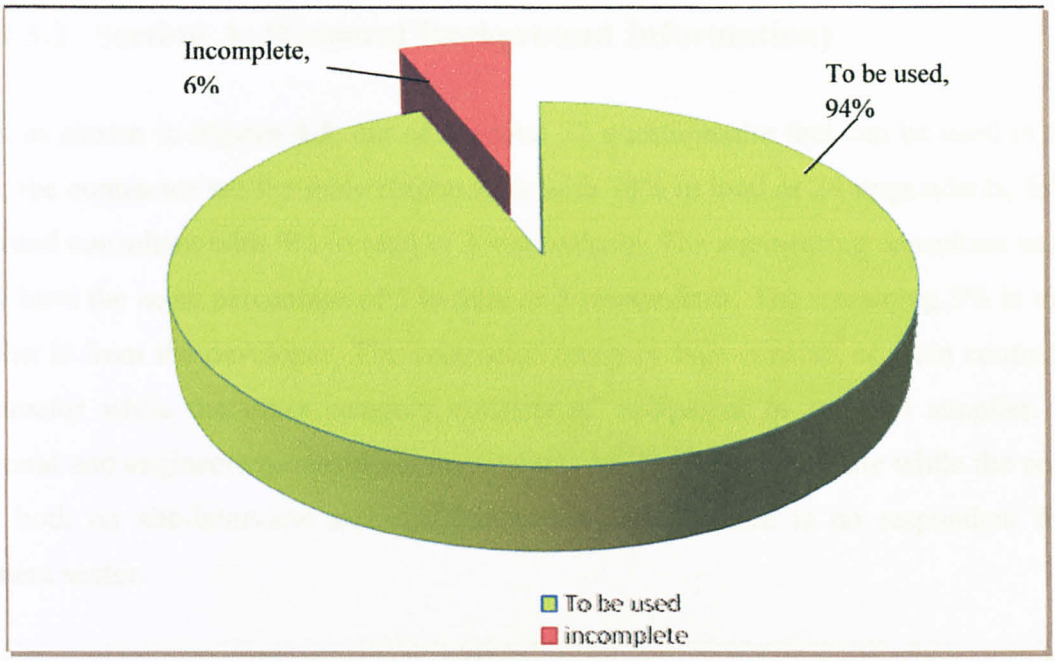


Figure 4.2 Percentage of Questionnaire to be used in Data Analysis

From the **Figure 4.2,** out of the total of 34 respondents, only 32 respondents or 94% in total can be use in the data analysis. The remaining 2 respondents or 6% in total will not be used in the analysis because the questionnaire is incomplete.

4.3.2 Section A: (General Background Information)

The data as shown in **Figure 4.3**, out of the total 32 questionnaire that can be used in the data analysis, the contractor are the main respondents with 74% in total or 24 respondents, follow by architectural consultant with 9% in total or 3 respondents. The engineering consultant and others category have the same percentage of 7 in total or 2 respondents. The remaining 3% in total or 1 respondent is from the developer. The contractor category here consists of main contractor and sub-contractor while the other category consists of equipment or material supplier. All the architectural and engineering consultant respondents are interviewed on site while the contractor is from both on site-interview and emailed methodology. There is no respondent from the government sector.

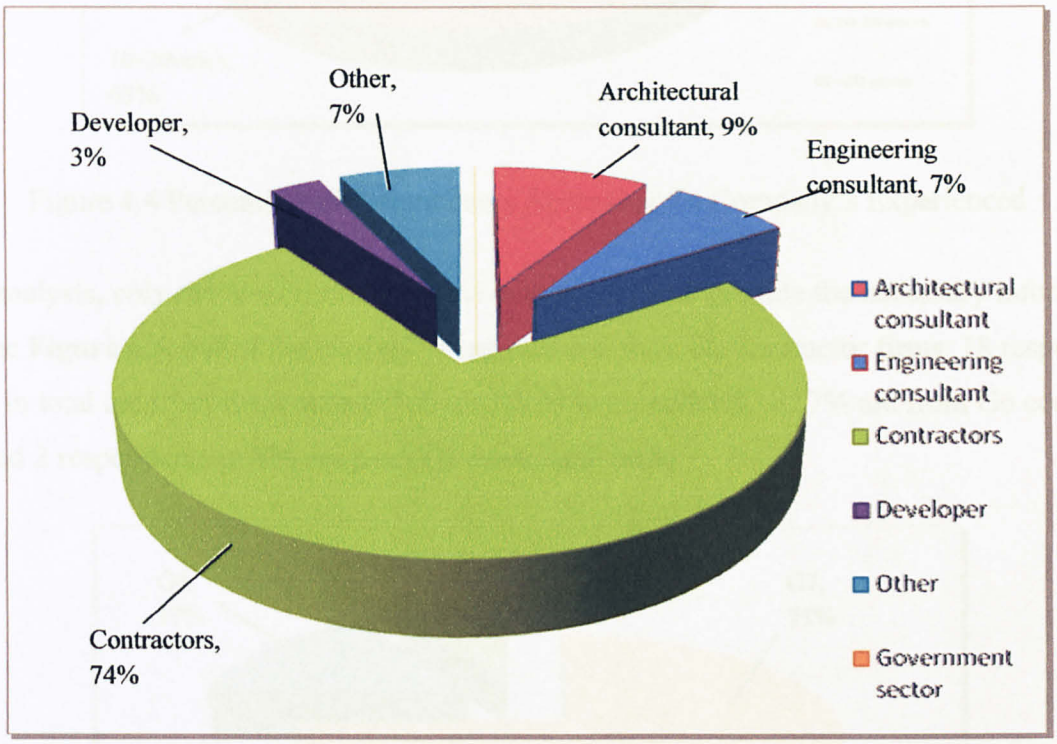


Figure 4.3 Type of Firm Involved

Based on the 32 respondent's questionnaire according to company experience, 7 respondents or 22% in total have experiences of between 5 to 10 years (5-10) in the construction industry, while 20 respondents or 63% in total have the experiences in the construction industry of between 10 to 20 years (10-20). Only 5 respondents or 15% in total have experienced of more than 20 years. There are no respondents with the experience of below 5 years. **Figure 4.4** below show the percentage of respondents according to their company experience in the construction industry.

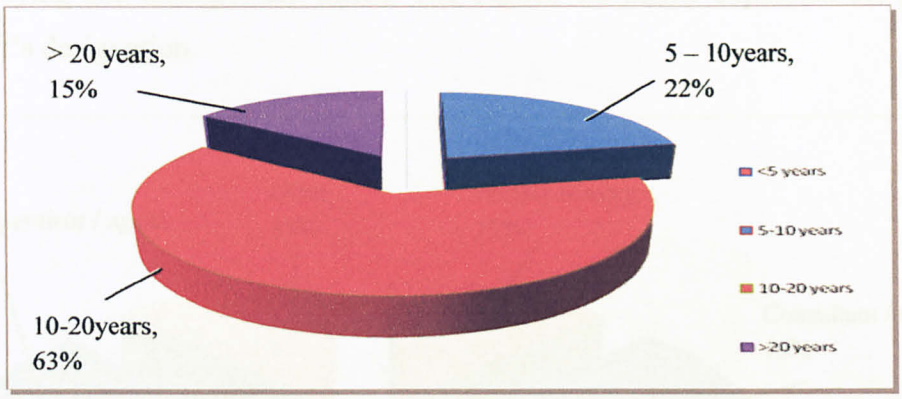


Figure 4.4 Percentage of Respondents According To Company's Experienced

In this analysis, only the respondent from the contractor firms provide the necessary information. From the **Figure 4.5**, out of the total of 24 respondents from the contractor firms, 18 respondents or 75% in total are from firms with G7 status while 4 respondents or 17% are from G6 contractor firms and 2 respondents or 8% are from G5 contractor firms.

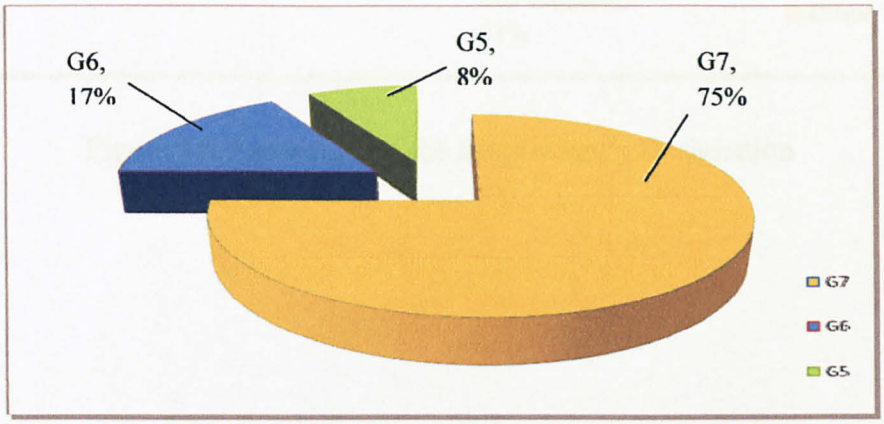


Figure 4.5 Respondent's Percentage according To CIDB Registration Grade of Contractor

From the 32 completed questionnaires, the highest respondents are Site Engineer (civil/mechanical/electrical) with 10 respondents or 31% in total followed by site supervisor/site agent with 6 respondents or 19% in total. There are 5 respondents or 15% in total from consultant/ clerk of work while the respondents of project manager and others category level with 4 respondents or 13% in total. The others category consists of are from equipment/material supplier and sub-contractors. The remaining 3 respondents or 9% in total are respondents from Quantity surveying and management office. The **Figure 4.6** below explained the percentage of the respondent's designation.

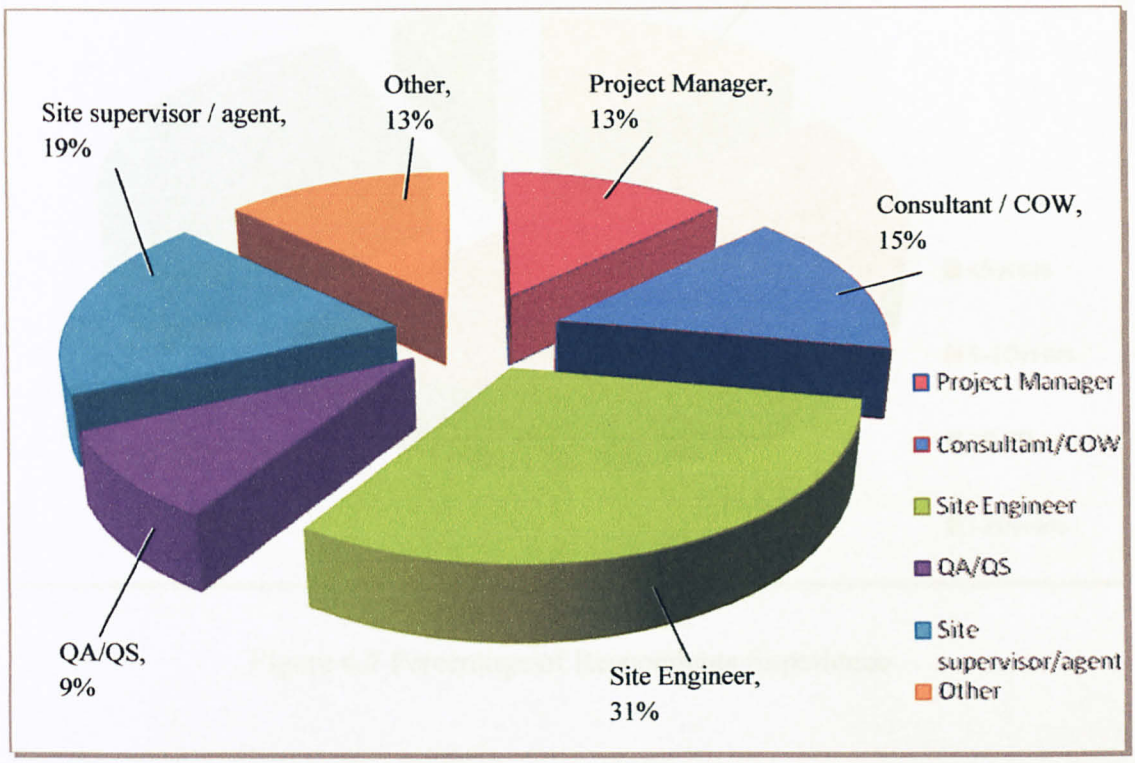


Figure 4.6 Percentage of the Respondent's Designation

Figure 4.7 below show the percentage of experience and involvement of individual respondent in the construction industry. From the total of 32 individual respondents, 5 respondents or 16% in total have less than 5 years of experience and there are 15 respondents or 47% in total have the experience between 5 to 10 years while there are 10 respondents or 31% in total have the experience of between 10 to 20 years. The remaining 2 respondents or 6% in total have more than 20 years of experience in the construction industry.

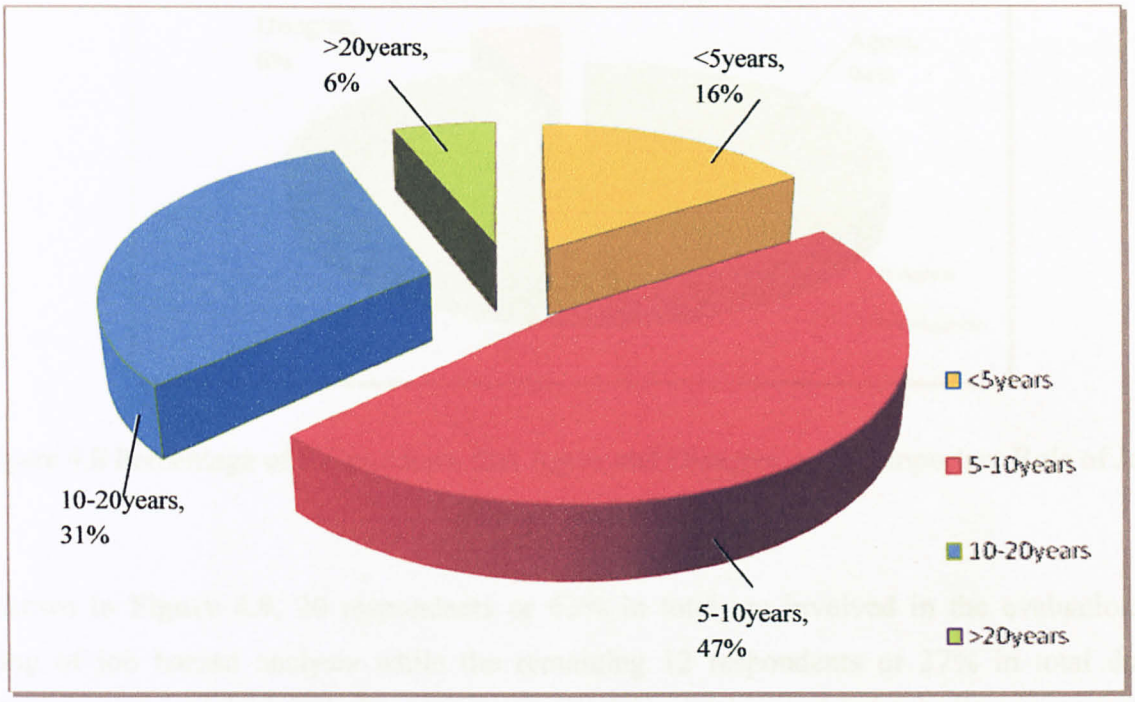


Figure 4.7 Percentage of Respondents Experience

4.3.3 Section B: (Survey on Completed Project)

The **Figure 4.8** shows the percentage of respondents that agree and disagree on the important role of job hazard analysis. From the total of 32 completed questionnaires, 30 respondents or 94% in total agree that job hazard play an important role in reducing the number of accidents and fatalities in the construction site while only 2 respondents or 6% in total disagree with it.

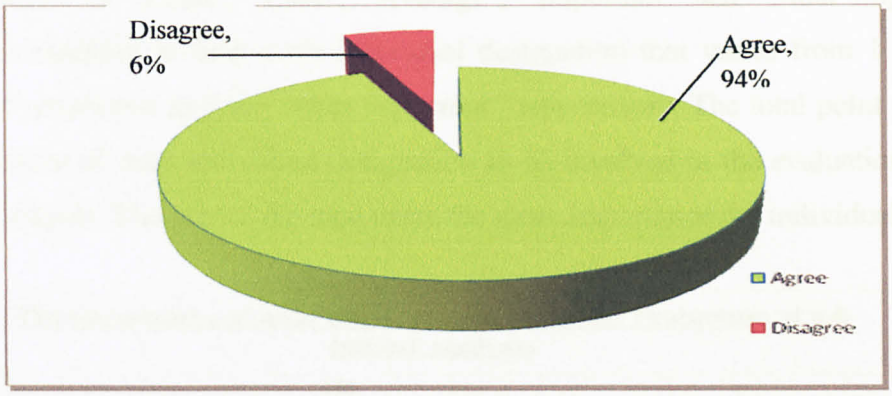


Figure 4.8 Percentage of Respondents that Agree and Disagree on the Important Role of Job Hazard Analysis

As shown in **Figure 4.9**, 20 respondents or 63% in total are involved in the evaluation and making of job hazard analysis while the remaining 12 respondents or 37% in total do not involved in the evaluation.

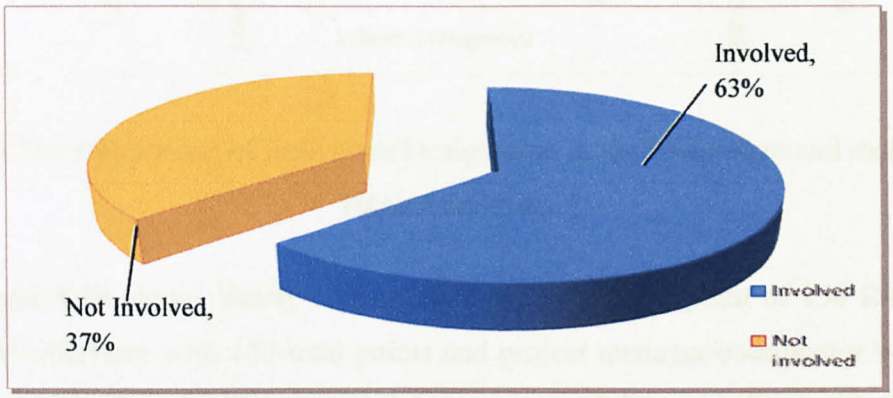


Figure 4.9 Percentage of Respondent's Involvement in the Evaluation of Job Hazard Analysis

This question required respondents to answer on the level of importance of the individual designation that involved in the evaluation and making of job hazard analysis. The individual designation involved consists of project manager/coordinator, site agent/engineer/supervisor, safety officer, labours in the construction site, site consultant such as architectural and engineering and clerk of work at site, material and equipment supplier and lastly the sub contractors involved in the construction site. Here, the respondents are given 5 choices of answer rating that consists of "Least", "Less", "Average", "Important" and "Most Important". The respondents are required to rank each individual designation that varies from 1 represent the scale of "*Least*" important to 5 for "*Most important"* respectively. The total point will show the level of importance of each individual designation to be involved in the evaluation and making of job hazard analysis. The higher the total point the more importance the individual designation.

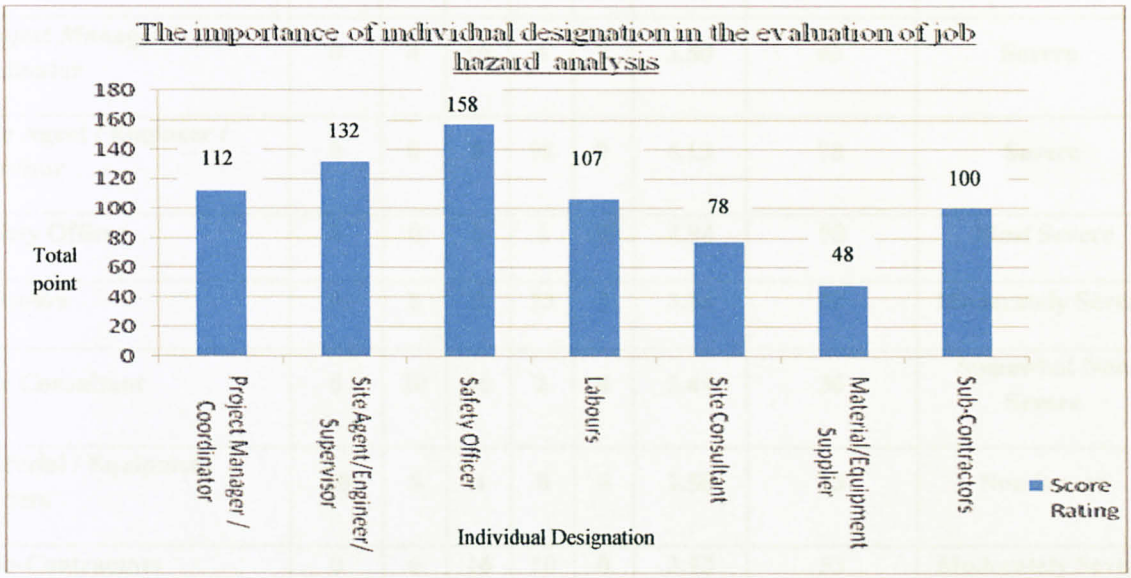


Figure 4.10 The Importance of Individual Designation in the Evaluation and making of Job Hazard Anlaysis

From the **Figure 4.10** above, Safety officer has the highest total point of 158 followed by site agent/engineer/supervisor with 132 total points and project manager/coordinator with total point of 112. Both construction site labours and Sub-contractors followed behind with the total points of 107 and 100 respectively. The lowest total points are site consultant and material/equipment supplier with only 78 and 48 respectively.

By using the analysis method of Severity Index from **4.2.1**, we can determine the severity of each individual designation. There are 5 type of severity that consists of "Non Severe", "Somewhat Severe", "Moderately Severe", "Severe" and "Most Severe". The range for the severity level are "0%-20%", "20%-40%", "40%-60%", "60%-80%" and "80%-100% respectively. Here from **Table 4.2**, shows the ranking of importance of individual designation based on the severity index. This table also consists of mean value and the percentage of severity index on the level of importance of each individual designation. The mean value for each individual designation is further shown in **Figure 4.11** and the percentage of severity index is further shown in **Figure 4.12.**

Individual / Designation	RESPONSE					MEAN	SEVERITY INDEX (%)	RANK
	1	2	3	4	5			
a) Project Manager / Coordinator	0	4	15	6	7	3.50	63	Severe
b) Site Agent / Engineer / Supervisor	0	0	5	18	9	4.13	78	Severe
c) Safety Officer	0	0	0	2	30	4.94	98	Most Severe
d) Labours	0	8	8	13	3	3.34	59	Moderately Severe
e) Site Consultant	0	20	10	2	0	2.44	36	Somewhat Non Severe
f) Material / Equipment Suppliers	20	8	4	0	0	1.50	13	Non Severe
g) Sub-Contractors	0	6	16	10	0	3.13	53	Moderately Severe

Table 4.2 The Ranking of Importance of Individual Designation Based On Severity Index

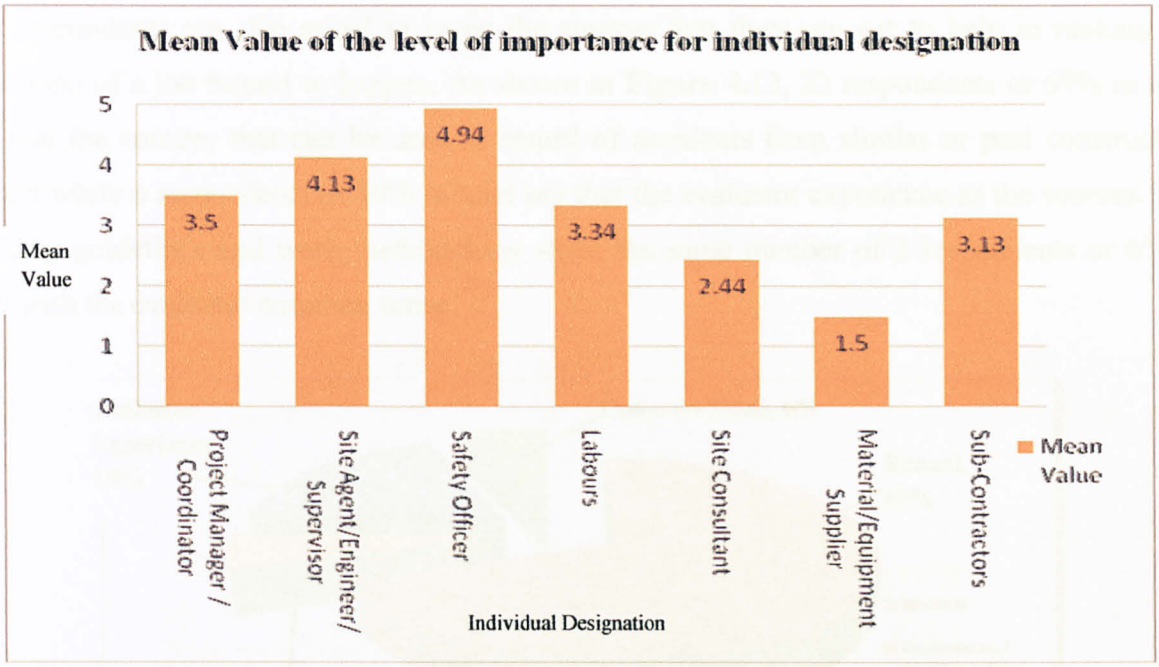


Figure 4.11 Mean Value for Each individual Designation

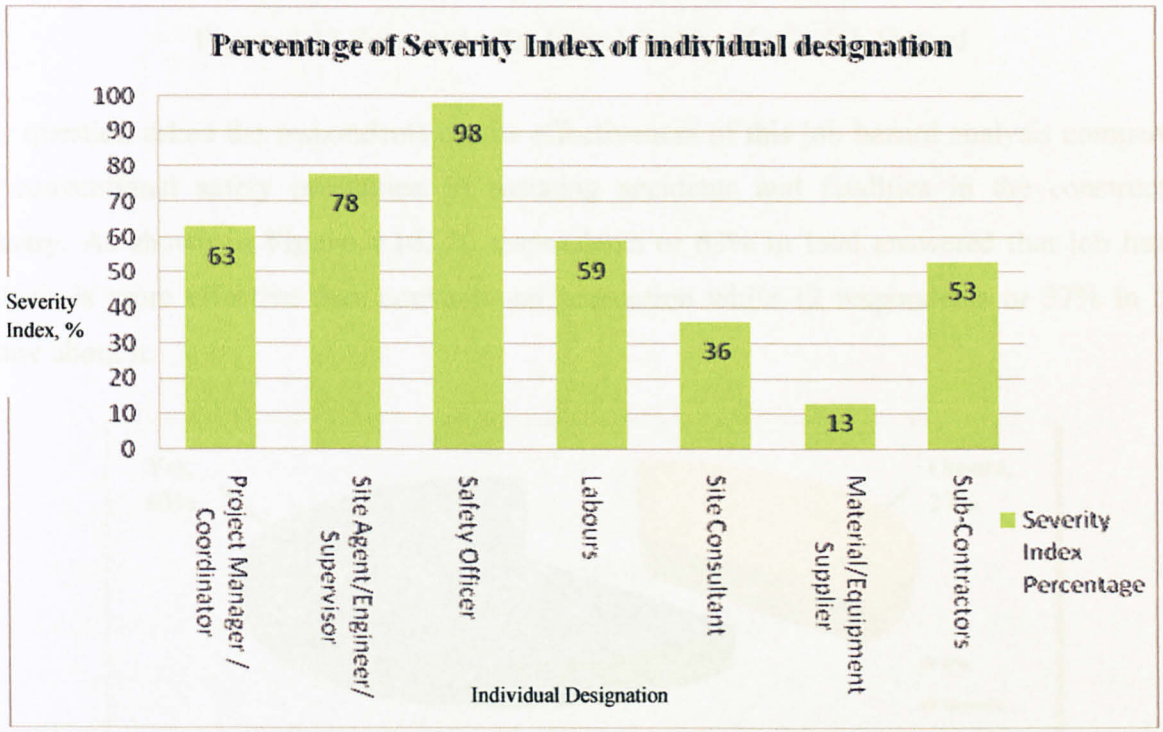


Figure 4.12 Percentage of Severity Index of Individual Designation

The respondents are also asked to name the sources that they can get to help in ranking the likelihood of a job hazard to happen. As shown in **Figure 4.13**, 22 respondents or 69% in total say that the sources that can be used is record of accidents from similar or past construction project while 6 respondents or 19% in total say that the evaluator experience as the sources. The working guidelines and work methodology share the same number of 2 respondents or 6% in total with the evaluator common sense.

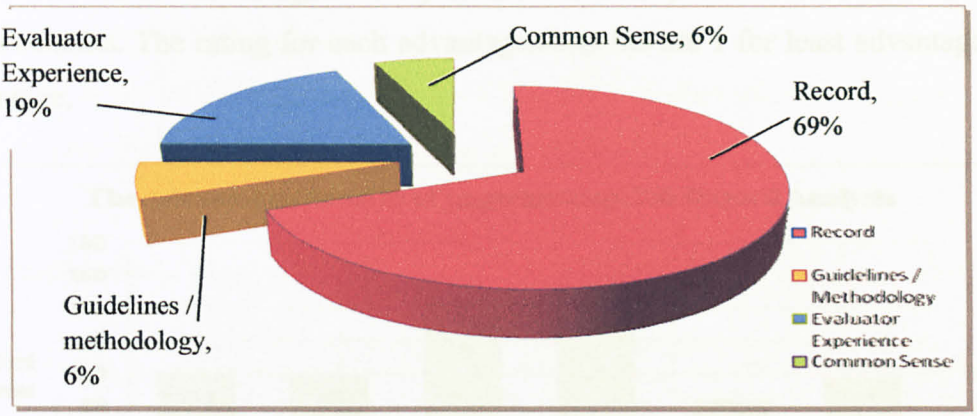


Figure 4.13 Sources to Rank the Likelihood of a Job Hazard

This question asked the respondents on the effectiveness of this job hazard analysis compare to the conventional safety precaution in reducing accidents and fatalities in the construction industry. As shown in **Figure 4.14**, 20 respondents or 63% in total answered that job hazard analysis is more effective than conventional precaution while 12 respondents or 37% in total unsure about it.

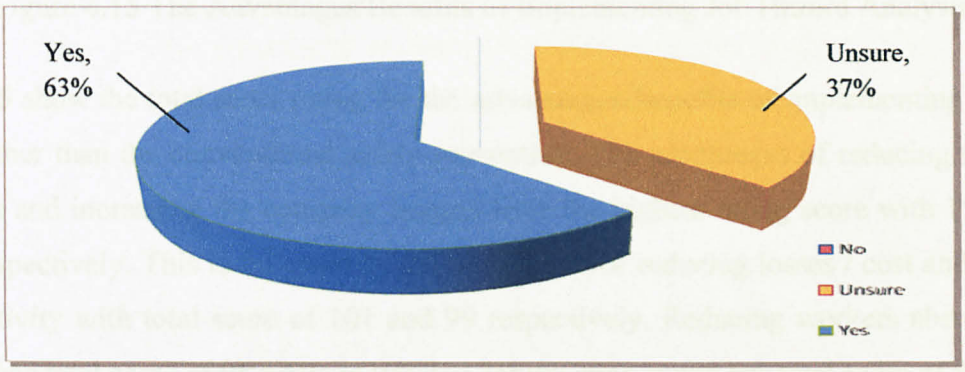


Figure 4.14 Effectiveness of Job Hazard Analysis compare to Conventional Precaution

The last question in this section asked the respondents to rate the **advantages/benefits** of implementing job hazard analysis rather than the conventional safety prevention. There are 6 choices of advantages/benefits to be rated by the respondents such as reducing loss and cost of construction, increasing the productivity, increasing the company image, reducing the number of fatalities, increasing the speed of construction and reducing the worker absenteeism and downtime. Here the respondents are given 5 choices of rating that consist of least, less, average, advantage and most advantages. Respondents are required to rank each type of advantages/benefits. The rating for each advantages/benefits are 1 for least advantage and 5 for most advantage.

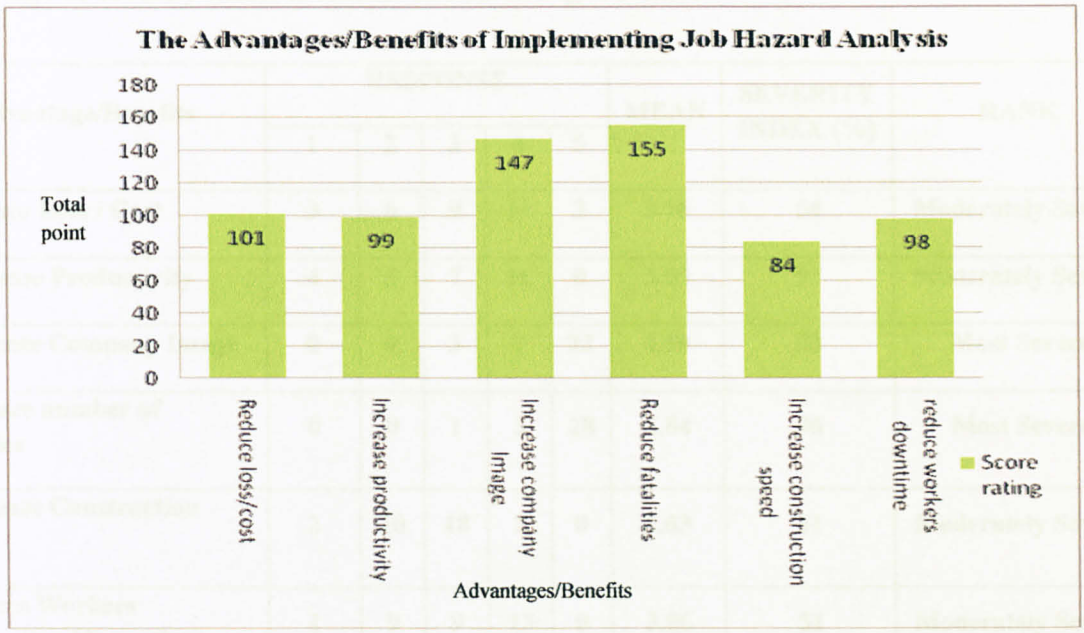


Figure 4.15 The Advantages/Benefits of Implementing Job Hazard Analysis

Figure 4.15 show the total score rating for the **advantages/benefits** of implementing job hazard analysis rather than the conventional safety prevention. The advantages of reducing the number of fatalities and increasing the company images have the highest rating score with 155 and 147 of score respectively. This is followed by the advantages of reducing losses / cost and increasing the productivity with total score of 101 and 99 respectively. Reducing workers absenteeism ad downtime has total score of 98 while increasing construction speed has total score of 84.

By using the analysis method of Severity Index from **4.2.1**, we can determine the severity of each individual designation. There are 5 type of severity that consists of "Non Severe", "Somewhat Severe", "Moderately Severe", "Severe" and "Most Severe". The range for the severity level are "0%-20%", "20%-40%", "40%-60%", "60%-80%" and "80%-100% respectively. Here from **Table 4.3**, shows the ranking of the **advantages/benefits** of implementing job hazard analysis rather than the conventional safety prevention. This table also consists of mean value and the percentage of severity index on the level of the **advantages/benefits** of implementing job hazard analysis rather than the conventional safety prevention. The mean value for each advantages/benefits is further shown in **Figure 4.16** and the percentage of severity index is further shown in **Figure 4.17.**

Advantage/Benefits	RESPONSE					MEAN	SEVERITY INDEX (%)	RANK
	1	2	3	4	5			
a) Reduce Loss / Cost	3	6	9	11	3	3.16	54	Moderately Severe
b) Increase Productivity	4	5	7	16	0	3.09	52	Moderately Severe
c) Increase Company Image	0	0	3	7	22	4.59	90	Most Severe
d) Reduce number of Fatalities	0	0	1	3	28	4.84	96	Most Severe
e) Increase Construction Speed	2	10	18	2	0	2.63	41	Moderately Severe
f) Reduce Workers Absenteeism / Downtime	1	9	9	13	0	3.06	52	Moderately Severe

Table 4.3 The Ranking of advantage/benefits Based On Severity Index

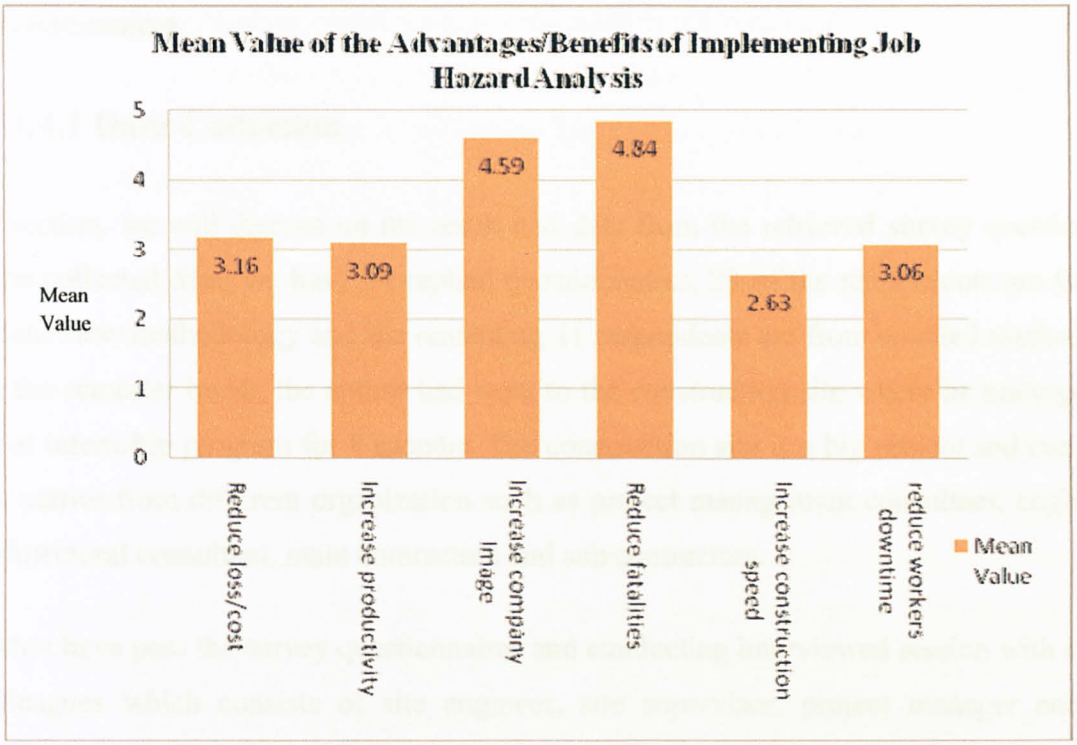


Figure 4.16 Mean Values of the Advantages/Benefits of Implementing Job Hazard Analysis

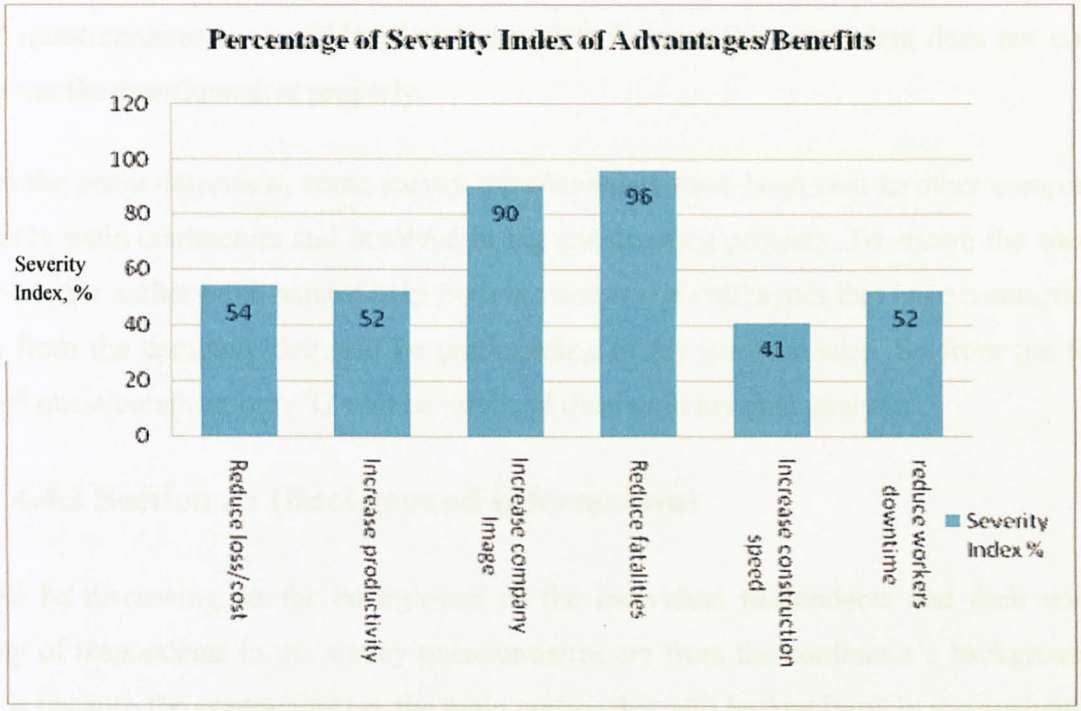


Figure 4.17 Percentage of Severity Index of Advantages/Benefits

4.4 Discussion

4.4.1 Data Collection

In this section, we will discuss on the result and data from the retrieved survey questionnaire. From the collected data, we have 34 replied questionnaires, 23 of the respondents are from the onsite-interview methodology and the remaining 11 respondents are from emailed methodology. During the semester break, the author had went to the construction site where he undergone his industrial internship program for 8 months. The construction site is a big project and consists of various parties from different organization such as project management consultant, engineering and architectural consultant, main contractors and sub contractors.

The author have pass the survey questionnaires and conducting interviewed session with some of his colleagues which consists of site engineer, site supervisor, project manager and some engineering and architectural consultant. Some questionnaires also have been passed to the sub contractors working at the site because they are the one mainly involved at work on site. From the 23 survey done at site, only 21 questionnaires will be used for my data analysis because the other 2 questionnaires are considered as incomplete because the respondent does not complete and answer the questionnaires properly.

Besides the onsite-interview, some survey questionnaires have been sent to other company that are mainly main contractors and involved in big construction projects. To ensure the success of the survey, the author have request help from his senior and colleagues that have connection with friends from the company that will be participating in my questionnaire. So from the total 34 retrieved questionnaires, only 32 will be used and discuss in my data analysis.

4.4.2 Section A: (Background Information)

We will be discussing on the background of the individual respondents and their company. Majority of respondents in the survey questionnaires are from the contractor's background. The reason is because the contractors are the main parties that will be involving in the evaluation and carrying of the job hazard analysis. The survey have also been conducted with other parties such

as the management office, site engineering and architectural consultant and the developer that involved in the construction industry. This is to ensure that the opinion and additional information regarding the implementation of the job hazard analysis in the construction site can be get from various parties.

Most of the respondent's company for the survey have the experience of 10 years or more. Only a small fraction of the respondent's company has lower experience and this is only from sub-contractor involved the sub-trade work on site. From the survey, majority of the respondent's company who involved and apply the job hazard analysis has the CIDB registration of grade G7 and G6. This information show that only the big company actively involved and carrying the job hazard analysis. This may due to several reasons, first of all, most of the big company are the main contractor and are responsible to comply with the legal requirement regarding the safety issues. Secondly, the big company always involved in big project which consists of various parties such as consultant firm, sub-contractors and large number of labours which required proper safety planning. Lastly, the big company are usually the main contractor on site and they are responsible to coordinate the safety issues with all other parties involved and working in the construction site.

Finally in this section, the survey also required the respondent to write about their designation and experience in the construction industry. From the retrieved survey questionnaire, most of the respondents are site engineer or other relevant position such as site supervisor, site agent and site coordinator because most of them involved directly on the work on site. The site engineers are from various disciplines such as civil, electrical and mechanical. Other designation such as project manager and site consultant or clerk of work also involved in the questionnaire because they are the one managing and supervising the work at the site and may have more experience on the safety issues on certain work on site. Most of the respondents have the experience of more than 5 years in the construction site.

4.4.3 Section B: (Survey on Completed Project)

There are 6 questions and it is aim of answering the objective of my survey project. In the first question, 94% of the respondent agrees that design for safety through job hazard analysis play an important role in reducing the number of accidents and fatalities in the construction site, only 6% or 2 respondents disagree with it. The reason is that the respondents believe the accident happen due to God's will and human error. In question two, 20 respondents said that they are involved in the evaluation of the job hazard analysis and only 12 respondents that are not involved. Most of the involved respondents are those from the contractor firm such as project manager, safety officer, site engineer and site supervisor. The reason is that they are the one responsible to manage and supervise the work at site and they have adequate information or understand the job scope better than other parties. The 12 respondents that are not involved in the evaluation are those from consulting firm and managing office because the evaluation is not their responsibility and their tasks only focus on supervising the progress and quality of work done.

In question three, respondents are asked to rank the level of important of the individual designation in the involvement of evaluating and carrying the job hazard analysis. Respondents are given 5 choices of ranking from 1 (least) to 5 (most important). Based on the **Table 4.2**, Safety officer on site and site engineer / supervisor / agent have the mean value ranking of 4.94 and 4.13 and fall under "most severe" and "severe" based on severity index analysis respectively. This is expected because safety officer are the one responsible for the safety issues in the construction site while the site engineer / agent / supervisor are the one supervising and working closely at the site. Other designation such as project manager/coordinator, labours and sub-contractors at the site have the average rating of above 3 and based on the severity index analysis, they fall under the category of "severe" and "moderately severe". Their involvement in the evaluation is less important compare to safety officer and site engineer / agent / supervisor because they have other responsibility. The sub-contractors is in the average rating because they only involved and specialise in their own trade work and only the sub-contractors coordinator suitable to be involved in the evaluation. Not all labours will be involved in the evaluation because this will affect the work progress. Only senior labours or the head of labours are required to be involved in the evaluation and they may communicate and share the information

to other labours later on. This may due to several reasons, firstly, only head of labours will stay throughout the construction project, other labours may leave after certain work is done and since most of the labours in the construction are foreigner, they will leave when their permits has expired. Secondly, there are a large number of labours at the site, some project may have up to 1000 of labours, and therefore the head of labours is the most suitable person to evaluate on behalf of the labours and share the information with others later on. Lastly, labours are the one working most closely and stay at the site most of the time; therefore the involvement of them is essential. Besides that, site consultant and material / equipment suppliers have the lowest rating and fall into the severity index category of "Somewhat Severe" and "Non Severe". This result is expected because site consultant is merely on supervising the work progress and quality but they may provide necessary advice on the safety issues based on their experience. Lastly the material / equipment suppliers do not stay at the site most of the time; the only thing they can assist in the evaluation is by providing the material or equipment handling guidelines to the evaluator of job hazard analysis.

In question 4, the respondents were asked to identify the sources they can get to rank the likelihood of a potential job hazard to happen. Majority of the respondents choose the record of accident of the similar job from past and other construction site. The record may help us to predict and provide better precaution so that the same accident would not happen again. The evaluator experience are also one of the sources that chosen by 6 respondents. According to them, a working experience at the site is essential because some work may still have potential hazard although no accidents or fatalities had happen before. The working guidelines and methodology and evaluator common sense have 2 respondents respectively. To evaluate a potential job hazard, work guidelines can provide an overview on the step by step involve in a particular work. As for the question five, 63% of the respondents agree that job hazard analysis is more efficient compare to the conventional way of safety prevention while only 37% unsure about it. This may due to that they does not involve directly to the evaluation or not aware with the progress and advantage from the job hazard analysis.

Finally in this section, the last question asked about the advantages and benefits that the respondents may get from implementing this design for safety through job hazard analysis. Respondents are required to rank each advantages/benefits from the scale of 1 (least) to 5 (most advantage). From **table 4.3,** the most advantages of implementing the job hazard analysis is by reducing the number of accidents and fatalities in the construction site and increasing the company image. Both category have the rating of 4.84 and 4.59 respectively and fall under the "Most Severe" based on the severity index. In job hazard analysis, all job-scope is being examined and evaluate from the beginning to the end of a certain work and this helps in identifying not only the potential hazard but it also enable the evaluator to provide an effective prevention or precaution method so that the accidents will not happen. Therefore from the survey, we can see that the most advantages by implementing the job hazard analysis rather than the conventional prevention is that it helps reducing the number of accidents and fatalities in the construction site and therefore the image of the contracting company will be increase. Besides that, the property loss and cost of insurance and compensation to those involved in accidents can be reduced. When an accidents or fatalities happen, the site may have to close for few days due to authorities' investigation; this can be prevented if the number of accidents and fatalities is reduced. Therefore it reduces the absenteeism and downtime of workers at the construction site and this helps increase the work productivity and improve the work progress at the site.

4.4.4 Section C: (Opinion Survey)

In this section, the respondents are required to give their subjective opinion on some issue related to implementing the job hazard analysis. There are two questions in this section, the first question aim to identify the problem that the respondents or the evaluator may faces when evaluating or carrying the job hazard analysis in the construction site. The second question aim to identify if there is other or additional advantages or benefits for implementing the job hazard analysis rather than the conventional safety precaution.

There are a lot of comments given by the respondents in question one but majority of the respondents stated that the main problem they may faced is ***no commitment*** and ***cooperation*** from all parties that involved in the evaluation such as the sub-contractors and labours in the construction site. Besides that, ***time constraint*** is another problem because most of the labours are rushing for work done to meet the dateline. A respondent which is a safety officer mention that ***most of the involved parties are expecting the safety officer to do the entire job hazard analysis evaluation***. Another problem stated in the questionnaire is that the evaluator does ***not have enough information*** on the work methodology that will enable them to evaluate the job hazard. Other answer is that there is ***no follow up after the evaluation*** and the job hazard analysis are merely to meet the legal requirement. Besides that, some contractors may ***cover up some work methodology*** and this may prevent the throughout evaluation of certain work at construction site.

In this question two, most of the site consultant comments that this job hazard analysis ensures that the contractors ***meeting the legal requirement on safety issues*** and help to identify the potential hazard of certain work in the construction site and may help to ***prevent it by providing an earlier and effective solution***. On the other hand, from the point of view of respondents that consists of mostly contractors, they mentioned that by evaluating the job hazard analysis, they are able to ***communicate with the labours and sub-contractors*** and in the same time be able to ***discuss on the work progress*** at the construction site.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

Safety and Health in the construction industry are important issues that required proper attention because of its significant role in the nation economic growth. A good safety and health management will not only save life and reduce property damage but it can help increase productivity and quality of work done. As recently, there are more awareness on looking toward the upstream activities such as designing and planning for safety before the work is commenced at the site. Hazard analysis is one of the designs for safety method that can be adopted.

The survey methodology used in the study had gather information regarding the safety and hazard analysis issue from the construction industry related organization or individual. The result from the survey has been used to analyze on the effectiveness of implementing hazard analysis or design for safety in the construction site in reducing the numbers of accident and fatalities.

This project can be further improved by conducting more survey and observation of the implementation of hazard analysis in the construction site. The involvement of more experienced and knowledgeable individual are important as well.

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APPENDIX A

Section A: General / Background information

Please fill in the blanks or tick in the [ ] provided.

I. Company:

1. Name of Company: _____
2. State the type of firm involved

   [ ] Government Sector [ ] Developer [ ] Contractor

   [ ] Engineering Consultant [ ] Architect Consultant

   [ ] Other, please state _____
3. Company's experience in building construction? (Years)

   [ ] <5 [ ] 5-10 [ ] 10-20 [ ] >20
4. CIDB Registration grade of the company

   [ ] None [ ] G1 [ ] G2 [ ] G3 [ ] G4 [ ] G5 [ ] G6 [ ] G7

II. Respondents

1. What is your designation with the company?

   [ ] Owner/Investor [ ] Project Manager [ ] Architect / Clerk of Work

   [ ] Site Engineer [ ] Quantity Surveyor [ ] Site Supervisor / Site Agent

   [ ] Other, please state _____
2. Respondent's experience in construction industry? _____ years

Section B: Survey on Completed Project
Please fill in the blank or tick in the [ ] provided

1. Does job hazard analysis play an important role in reducing the number of accidents and fatalities in the construction site?

   [ ] Yes [ ] No

2. Do you involved in the evaluation and making of job hazard analysis?
   [ ] Yes [ ] No

3. In your opinion, what are the level of importance of the individual below that involved in the evaluation and making of job hazard analysis?
   (*Please rate the answer according to your understanding)*

   1- Least, 2- Less, 3- Average, 4- important, 5- Most important

	(1)	(2)	(3)	(4)	(5)
Project Manager/Coordinator	[ ]	[ ]	[ ]	[ ]	[ ]
Site Agent/Supervisor/Engineer	[ ]	[ ]	[ ]	[ ]	[ ]
Safety Officer	[ ]	[ ]	[ ]	[ ]	[ ]
Labours	[ ]	[ ]	[ ]	[ ]	[ ]
Site Consultant	[ ]	[ ]	[ ]	[ ]	[ ]
Material/Equipment Suppliers	[ ]	[ ]	[ ]	[ ]	[ ]
Sub contractors	[ ]	[ ]	[ ]	[ ]	[ ]

4. Where do you get the sources to rank the likelihood of a job hazard to happen?

   [ ] Record of accident of the similar job from other construction site
   [ ] Work guidelines and methodology
   [ ] Evaluator experience
   [ ] Common Sense

5. Does job hazard analysis more efficient than the conventional safety precaution in reducing the number of accidents and fatalities?

   [ ] Yes [ ] No [ ] Unsure

6. In your opinion, which are the **advantages/benefits** of implementing job hazard analysis rather than the conventional safety prevention?
(***Please rate only once for each advantage category)***

1- Least, 2- Less, 3- Average, 4- advantage, 5- Most advantage

	(1)	(2)	(3)	(4)	(5)
Reduce loss / Cost	[ ]	[ ]	[ ]	[ ]	[ ]
Increase Productivity	[ ]	[ ]	[ ]	[ ]	[ ]
Increase Company Image	[ ]	[ ]	[ ]	[ ]	[ ]
Reduce number of fatalities	[ ]	[ ]	[ ]	[ ]	[ ]
Increase construction speed	[ ]	[ ]	[ ]	[ ]	[ ]
Reduce worker absenteeism/downtime	[ ]	[ ]	[ ]	[ ]	[ ]

Section C: Opinion Survey

Please give comment and opinion related to the question given

1. Please state the problems commonly occurs when evaluating and carrying the job hazard analysis

_____
_____
_____
_____

2. In your opinion, what are the additional advantages/benefits for implementing the job hazard analysis rather than the conventional safety precaution?
(*Besides indicated in section B, question 6*)

_____
_____
_____
_____

Section D: Feedback

1) Please indicate whether you wish to receive a copy of the result of this study

[ ] Please send me a copy of the result

[ ] Please do not send me the copy of the result.

APPENDIX B

Severity Index for the level of importance of the individual below that involved in the evaluation and making of job hazard analysis

ADVANTAGE/ATTRACTION	PERCEPTION	RESPONDENTS,xi	CONSTANT, Xi	ai.xi/∑xi	TOTAL ai.xi/∑xi	SEVERITY INDEX [(total ai.xi/∑xi)/(4x32)]	CATEGORY OF SEVERITY
a) Project Manager / Coordinator	Least	0	1	0	112	63	Severe
	Less	4	2	8			
	Average	15	3	45			
	Important	6	4	24			
	Most Important	7	5	35			
b) Site Agent / Supervisor / Engineer	Least	0	1	0	132	78	Severe
	Less	0	2	0			
	Average	5	3	15			
	Important	18	4	72			
	Most Important	9	5	45			
c) Safety Officer	Least	0	1	0	158	98	Most Severe
	Less	0	2	0			
	Average	0	3	0			
	Important	2	4	8			
	Most Important	30	5	150			
d) Labours	Least	0	1	0	107	59	Moderately Severe
	Less	8	2	16			
	Average	8	3	24			
	Important	13	4	52			
	Most Important	3	5	15			
e) Site Consultants	Least	0	1	0	78	36	Somewhat Non Severe
	Less	20	2	40			
	Average	10	3	30			
	Important	2	4	8			
	Most Important	0	5	0			
f) Material / Equipment Suppliers	Least	20	1	20	48	13	Non Severe
	Less	8	2	16			
	Average	4	3	12			
	Important	0	4	0			
	Most Important	0	5	0			
g) Sub-Contractors	Least	0	1	0	100	53	Moderately Severe
	Less	6	2	12			
	Average	16	3	48			
	Important	10	4	40			
	Most Important	0	5	0			

***The Total Respondent are 23 Respondents**

Legend	
0% - 20%	Non Severe
20% - 40%	Somewhat Non Severe
40% - 60%	Moderately Severe
60% - 80%	Severe
80% - 100%	Must Severe

APPENDIX C

Severity Index for the ranking of advantage/benefits of implementing job hazard analysis

ADVANTAGE/ATTRACTION	PERCEPTION	RESPONDENTS,xi	CONSTANT, Xi	ai.xi/∑xi	TOTAL ai.xi/∑xi	SEVERITY INDEX [(total ai.xi/∑xi)/(4x32)]	CATEGORY OF SEVERITY
a) reduce loss/cost	Least	3	0	0	69	54	Moderately Severe
	Less	6	1	6			
	Average	9	2	18			
	advantage	11	3	33			
	Most advantage	3	4	12			
b) increase productivity	Least	4	0	0	67	52	Moderately Severe
	Less	5	1	5			
	Average	7	2	14			
	advantage	16	3	48			
	Most advantage	0	4	0			
c) increase company image	Least	0	0	0	115	90	Most Severe
	Less	0	1	0			
	Average	3	2	6			
	advantage	7	3	21			
	Most advantage	22	4	88			
d) reduce number of fatalities	Least	0	0	0	123	96	Most Severe
	Less	0	1	0			
	Average	1	2	2			
	advantage	3	3	9			
	Most advantage	28	4	112			
e) increase construction speed	Least	2	0	0	52	41	Moderately Severe
	Less	10	1	10			
	Average	18	2	36			
	advantage	2	3	6			
	Most advantage	0	4	0			
f) reduce workers absenteeism / downtime	Least	1	0	0	66	52	Moderately Severe
	Less	9	1	9			
	Average	9	2	18			
	advantage	13	3	39			
	Most advantage	0	4	0			

***The Total Respondent are 23 Respondents**

Legend	
0% - 20%	Non Severe
20% - 40%	Somewhat Non Severe
40% - 60%	Moderately Severe
60% - 80%	Severe
80% - 100%	Must Severe