

FACTOR OF WORK ACCIDENT IN INDONESIAN
CONSTRUCTION SITE: MEDAN, INDONESIA

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FACTOR OF WORK ACCIDENT IN INDONESIAN CONSTRUCTION SITE:
MEDAN, INDONESIA

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DEDICATION

The most special dedication for...

My beloved father and mother

Teuku Muhammad Johan and Suraiya Dahlan

*Your patience, tremendous care, tireless support and wise advice always
motivate me to become better person*

My Brother and Sister

Teuku Muhammad Rikza Abdy

Cut Amalia Saffiera

*Wish you guys will achieve successful life and be useful human for your self,
nation and religion*

All of my best friends and relatives

*Thank you for being there whenever I need and always give help whenever I face
problems*

Last but not least,

*All of my teachers, lectures and entire people who have involved in my life
Thank you for your precious contribution until I am being what I am now*

Thank You Very Much

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ABSTRACT

Indonesia experienced poor occupational safety and health issue because the work accident's rate still increased. In fact, 32% of the accidents are derived from construction industry. Medan as one of big city in Indonesia was chosen to run this research following some fatal accidents happened in its construction site. 6 categories of work accident's factors have been taken account for this research which consists of unsafe equipment, unsafe work site, unique nature of industry, unsafe method, human error and poor management. The objective of this research is to identify the factor that significantly contributes to work accident in Medan construction site as well as the preventive solution. The objective is assessed based on 2 respondent's perspectives which consist of Indonesian construction board and contractors in Medan. The perception of Indonesian construction board's Expert has been studied to identify the factor of work accident and preventive solution on all of the factors. Contractor's perception which represented by professional worker also has been investigated to identify the accident's factors which happened mostly in Medan construction site. 2 methods of data collection are applied namely interview and questionnaire. Interview is used to obtain the data from construction board's expert while questionnaire is used to collect the data from contractors. Interview data has been analyzed using content analysis while the questionnaire data was analyzed using descriptive and explanatory analysis. In conclusion, Expert of Indonesian construction board perceived human error as most impactful factor while contractor perceived unique nature of industry as highest factor contribute of work accident in Medan. The preventive solutions are basically recommended in term of providing better monitoring program, improve supervision and training to workers, select competent worker and periodically check all of the equipment.

ABSTRAK

Indonesia mengalami isu keselamatan dan kesihatan kerja yang buruk kerana kadar kemalangan kerja masih meningkat. Malah, 32% daripada jumlah kemalangan diperolehi daripada industri pembinaan. Medan sebagai salah satu bandar besar di Indonesia telah dipilih untuk menjalankan kajian ini disebabkan beberapa kemalangan maut yang pernah berlaku di tapak pembinaan kota Medan. 6 kategori faktor kemalangan kerja telah diambil kira dalam kajian ini yang terdiri daripada peralatan yang tidak selamat, tempat kerja yang tidak selamat, keunikan industri, kaedah yang tidak selamat, kesilapan manusia dan pengurusan yang lemah. Objektif kajian ini adalah untuk mengenal pasti faktor tertinggi yang memberi sumbangan ketara pada kemalangan kerja di tapak pembinaan kota Medan serta cara pencegahannya. Objektif dinilai berdasarkan perspektif 2 responden yang terdiri daripada lembaga pembinaan Indonesia dan kontraktor di Medan. Persepsi dari pakar lembaga pembinaan Indonesia telah dikaji untuk mengenal pasti faktor kemalangan kerja dan cara pencegahan pada semua faktor tersebut. Persepsi kontraktor yang diwakili oleh pekerja profesional juga telah disiasat untuk mengenal pasti faktor kemalangan yang paling banyak berlaku di tapak bina kota Medan. 2 kaedah pengumpulan data digunakan iaitu temuduga dan soal selidik. Temuduga digunakan untuk mendapatkan data dari pakar pembinaan lembaga manakala soal selidik digunakan untuk memperolehi data daripada kontraktor. Data temuduga dianalisis menggunakan analisis kandungan manakala data soal selidik dianalisis dengan menggunakan analisis deskriptif dan penjelasan. Kesimpulannya, Pakar lembaga pembinaan Indonesia melihat kesilapan manusia adalah faktor yang paling berkesan manakala kontraktor melihat keunikan industri sebagai faktor yang tertinggi menyumbang pada kemalangan kerja di Medan. Cara pencegahan pada dasarnya dianjurkan dari segi menyediakan program pemantauan yang lebih baik, meningkatkan pengawasan dan latihan kepada pekerja-pekerja, memilih pekerja yang kompeten dan secara berkala memeriksa semua peralatan.

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LIST OF SYMBOLS AND ABBREVIATIONS

A2K4	-	Asosiasi Ahli Keselamatan Kerja Konstruksi
GATT	-	General Agreement and Tariffs and Trade
ILO	-	International Labour Organization
LPJK	-	Lembaga Pengembangan Jasa Konstruksi
NIOSH	-	National Institute for Occupational Safety and Health
OSHA	-	Occupational Safety and Health Administration
OSHAS	-	Occupational Safety and Health Assessment Specification
PPE	-	Personal Protective Equipment
SWP	-	Safety Working Procedure
WTO	-	World Trade Organization
μ	-	Mean
$\sum X$	-	Total Value of X
N	-	Number of Values
VL	-	Very Low
L	-	Low
A	-	Average
H	-	High
VH	-	Very High
Mn	-	Mean
Md	-	Mode
TR	-	Total Respondent

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Accident is defined as an unexpected event, originally is undesirable which disrupt the process that has been set up from an activity and can lead to losses for human and or property, while work accident is unexpected and unplanned events that can cause injury, pain, loss in humans, goods and the environment (Suma'mur, 2004). In general, the losses caused by the accident can majorly cause 5 things which are; damages, organizational chaos, abnormality or defect, complaint and even death.

Accident in workplace must have happened due to some factors. Wibowo (2010) illustrate that the causes of accident at workplace can be viewed from 3 main aspects consist of human, environment as well as safety and work equipment. Furthermore the factor of accident has been classified into 2 main causes. Generally, accidents at work occur either due to unsafe working conditions and unsafe worker acts (Aksorn and Hadikusumo, 2007). Unsafe condition will happen at certain situation such as improper access for height work, equipment or machines that do not have perfect security system, bad lighting conditions, lack of airflow and so on (Fathoni, 2006). While unsafe act is behaviour, actions or deeds that will cause an accident (Aksorn and Hadikusumo, 2007).

Cesarini *et al.* (2013) emphasize that accidents are not inevitable. Therefore companies should have that kind of mindset. In the event that there is an accident, the facts and circumstances should be reviewed to identify root causes so that corrective action can be taken and future incidents can be prevented. The same attention should be paid to near misses that had the potential to become serious accidents. Regular accident review meetings between field managers and executives send a clear message that safety should be paramount.

1.2 Background of Study

In any work practice of an industry, it is surely contain high potential hazard. Accident, disease and injury can definitely give interference to the process of the work, routine and at the end can cause additional burden of cost and another loss. Research conducted by International Labor Organization (ILO) has found that in 2013 every 15 seconds, a worker dies from a work-related accident or disease. Every 15 seconds, 153 workers have a work-related accident. Continually, ILO stated that every day averagely 6,300 people die as a result of occupational accidents or work-related diseases. In overall, more than 2.3 million deaths occur per year. 317 million accidents happen on the job annually and many of these resulting in extended absences from work. The human cost of this daily difficulty is huge and the economic burden of poor occupational safety and health practices is estimated at 4 per cent of global Gross Domestic Product each year.

The threat of an accident at work in developing countries such as Indonesia is still very high. Based on National Social Security's statistic, nine people died per day. Three people in the workplace, six people in the time of work visit. The figure is relatively high compared to European countries where just as much as two people died two per day because of work accident (Suara Pembaharuan, 2015).

Indonesia placed worst position far below Singapore, Malaysia, the Philippines and Thailand in terms of safety and health level in South East Asia. This reflects the readiness of the Indonesian company's competitiveness in the international community is still very low. It needs to be improved because in the era of globalization and free markets of World Trade Organization (WTO) and General Agreement and Tariffs and Trade (GATT) that will apply in 2020, safety and health is one of the prerequisites specified in the economic relations of trade in goods and services between countries that must be met by all member states, including Indonesia (Sadam, 2013).

1.3 Problem Statement

The data from Indonesia Ministry of Labor and Transmigration (2013) revealed that the number of work accident happened in Indonesia is still increasing. As showed in

Figure 1.1 that in 2009 there are approximately 83,714 numbers of accidents occur in Indonesian work industry. Total of expenses to compensate the loss reached Rp. 219.7 Billion. Few years after, in 2013 the number of accidents bumped into 99,491 cases. The amount had increased 18% from the rate in 2009. The total of loss also had reached Rp. 504 Billion. The data revealed that 32% from total of work accidents in Indonesia is derived from construction site. It contributes the highest accident compared to manufacturing, mining and other industries. Out of 32% of the accidents, 26% is caused by falling from height, 4% is due to struck down while 2% is because of collision. The report also reveals that based on 32% of accidents happen in Indonesian construction site, 26% is caused by falling from height, 4% is due to struck down while 2% is because of collision (Ministry of Labour and Transmigration, 2013).

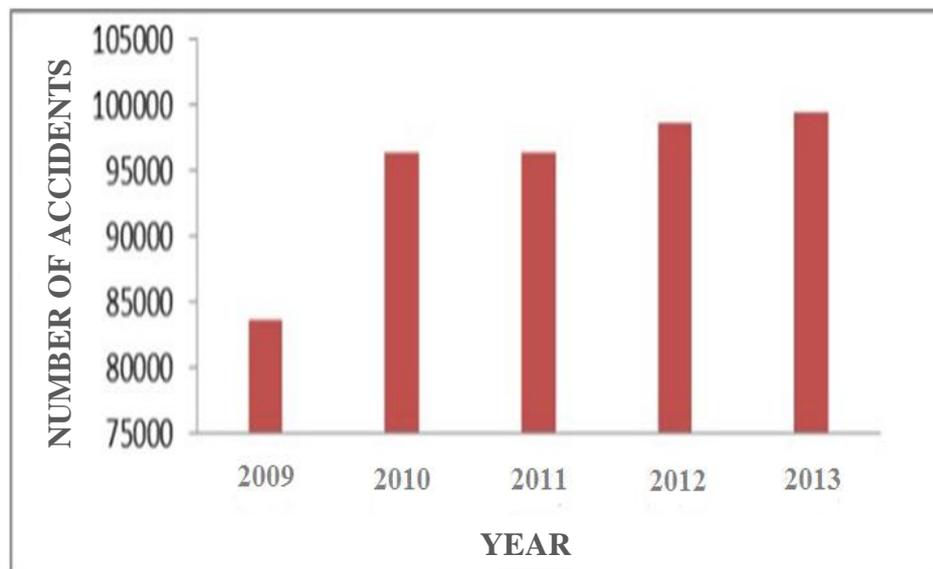


Figure 1.1: Graphical Data of Work Accident in Indonesia

Source: Ministry Labor of Indonesia (2013)

International Labor Organization (2013) came out with another shocking data which says that in 1 year averagely there are 99,000 cases of accidents in Indonesia where 70% of the workers ended up dead and long life disability. In other words, there is still serious problem of safety standard in Indonesia.

The next problems will be discussed specifically in where the research will be conducted. Medan as the city chosen to run this research appeared to experience series of construction problems. The problems occurred was derived from managerial problem and work accident. Based on the information gained from LPJK located at Medan, for the past few years Medan had quite some serious problem in their construction activity. According to Mrs. Murniati (2015) as Head of LPJK in North Sumatra, contractors and the local authority have not seriously applied safety and health management at site. Furthermore LPJK had also given information regarding some critical accidents happened in Medan. There are some fatal accidents happened at site which has been recorded in several national news such as:

- i. Construction worker killed by electric shock after doing electrical connection at Parliament building project (2010)
- ii. Workers fell and killed in Apartment Project (2015), Mega Mall project (2014) and Parliament building project (2012)
- iii. Crane failure where the boom part was disconnected at Kualanamu Airport project (2014)

According to LPJK, there are many accidents keep happening in construction site as this industry has been pushed to develop very fast in Medan. Those problems will be the main trigger to analyze further on what are the factors that cause work accident in Medan construction site. Accident rate in Indonesian industry is quite high compared to other developed countries. The main factor is actually due to low safety and health awareness, whether it is from management level or the workers (Sriwijaya Post, 2014).

Therefore, it is important to acquire person who is expert in the safety and health field of their respective companies. It is the big responsibility of the contractors as the main actor in construction to fulfill that requirement. Contractor must implement safety management system in order to reduce as much as possible the rate of accidents at site. The same goes to Indonesian construction board or known as LPJK as the facilitator. As an authorized government institution, LPJK has to make sure all of the contractors are doing the safety system correctly to achieve sustainable safety and healthy working environment in Indonesia.

1.4 Research Questions

There 3 main questions appeared in this research. The questions are:

- Q.1 What are the factors of work accident based on Indonesian construction board's (LPJK) perception in Medan construction site?
- Q.2 What are the factors of work accident based on contractor's perception in Medan construction site?
- Q.3 What are solutions to prevent those factors of work accident in Medan construction site?

1.5 Research Objective

This research has 3 main objectives:

- i. To study LPJK's perception on the factors of work accident in Medan construction site
- ii. To investigate contractor's perception on the factors of work accident in Medan construction site
- iii. To identify LPJK's perception on preventive solutions of factors of work accident based on in Medan construction site

1.6 Scope of Research

The scope and respondent of this research will only be within Medan construction industry. Since Medan is one of the developing city in Indonesia especially in terms of construction industry, researcher hopes the results of data collection in Medan can be one of the bench mark to know the factors of accident in Indonesian construction site. LPJK as Indonesian construction board will be the first respondent of this research. LPJK is the only institution to be used for interview since it is the only government institution that specifically manages construction industry. The expert from LPJK is recognized very competent to provide information on factor of work accident and preventive solution on the factors itself. The solutions obtained from the expert will be used to address the factor of work accident from contractor's point of view.

The second respondent is contractor in Medan. Contractor is main perpetrator to perform the construction activities at site. The contractors belong to B class contractors which recognized as top class contractors where they have involved with high cost and risk project. The contractors are also determined as building contractors because the accident case in Medan is mostly come from building project. Other class below such as M class or K class contractor will not be involved. Class M and K contractor are not involved in many high risk projects. It is because only 30% of M class contractors are implementing safety management system. Moreover, for Class K contractors, 90% of them are not applying safety management system. Therefore, class K and class M contractors are not suitable to be respondents in this research

The primary data taken from both respondents will be in the scope of safety and health especially related to accidents. Data collection from LPJK is using interview method, while contractors will be done by questionnaire. Further details will be explained in Methodology part of Chapter 3.

1.7 Significance of Research

This research will bring some benefits for some parties as follow:

i. Government

The government can improve safety and health standard of workplace to increase the quality of human resources and overall national development. The success of human resources will accelerate the process of achieving national goals.

ii. Company

Improve the quality of worker's life through development of safety and health at workplace. This may encourage workers to work more productively in order to increase company productivity

iii. Future Researcher

All future researchers might be encouraged to explore more and improve the safety and health issue of any company. The more the researchers do the research, the more solution will be found.

1.8 Conclusion

This chapter has introduced the preliminary concept of this research. There is high accident rate in Indonesian construction industry where it covers 32% of total of whole work accident. Medan is one of the developing city in construction had been experience some fatal accidents in past few years. The safety issue is the main problem to conduct this research in Medan. The objective of this research is to identify the factor of work accident in Medan construction site based on LPJK and contractors point of view. In addition, the preventive solution also will be identified after knowing all factor of work accident in Medan. This research is hoped to be benefited to contractor, government and future researcher to enhance safety level in Indonesia.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature may use primary reports with verbal form, but in the vast majority of cases reports are written documents. The types of scholarship may be empirical, theoretical, critical/analytic, or methodological in nature. A literature review also seeks to describe, summarize, evaluate, clarify and/or integrate the content of primary reports.

Along with this chapter, this research will look back at some scientific researches and related literature review in terms general concept of safety and health, factors of work accident, and also solution to all those factors of work accident. All of the topics will be discussed in terms of operational purpose for the research. Regarding the cause of accidents, this chapter will elaborate 6 classifications of factors that cause accident in construction site. The 6 classification of those factors will be explained in more details which supported by previous researcher results. Finally researcher will illustrate the conceptual idea of this research by representing research theoretical framework.

2.2 Definition of Concept

2.2.1 Safety and Health at Workplace

The terms safety and health workplace refers to the psychological and physical conditions of workers as the result of the environment provided by the company (Friend and Kohn, 2007). The procedure of safety and health was initially derived from OSH (Occupational Safety and Health) which is a discipline science to protect

the safety, health and welfare in the workplace. The idea of OSH was developed by drafting Occupational Safety and Health Act, signed by President Richard M. Nixon on 29th December 1970. This law initiated the establishment of NIOSH (National Institute for Occupational Safety and Health) and OSHA (Occupational Safety and Health Administration) in United States of America (US Department of Labour, 2006).

Consequently, OSHA started to expand through other countries. According to the information from *Occupational Safety and Health Academy*, OSHA was first introduced at South East Asia region in the year of 1993. During that time, OSHA was only accommodating a general occupational safety and health by consulting and training offerings to the industry in Malaysia. In a very short period of time, the company began to offer other services requested by existing clients that enhanced this initial service offering to other regional countries such as Indonesia, Myanmar, and Vietnam.

Safety and health of workers is an important thing to note. Simamora (2006) clarifies that companies should pay attention to provide safer and healthier condition or working environment, as well as being more responsible especially for organizations that have a high accident rate. Safe working environment and healthy will produce (i) increasing in productivity due to the declining number of lost working days, (ii) improving the efficiency and quality of workers to be more committed, (iii) decrease the cost of healthcare and insurance, (iv) greater flexibility and adaptability due to increase in participation and ownership and (v) better labour selection due to increased corporate image.

2.2.2 Construction Accident

Construction sites or building sites can be very unsafe places with various types of hazards. Some common threats occur in site are falling material and electrical faults as well as the dangers from power tools and working on scaffolding, faulty lifts and hoists, collapsing trenches and foundations, people working in close proximity to each other and the movement of internal construction site traffic (Hinze, 2003).

There is a popular belief that the construction site is dangerous and the risks faced by the workers are usual. The accidents happen may cause physical injuries or health illness in long term. Hazard that has risk of physical injury can cause direct injury to our worker at site and if severe can cause death. However, hazard that has risk of ill health can only be notified after long term of period and shall cause sickness or death after certain period of time (Rahim *et. al*, 2003).

2.3 Current Issue in Indonesian Construction Industry

Generally, occupational health and safety issues in Indonesia are often neglected. This is indicated by the high number of work accidents. In Indonesia, every seven seconds occurs one case of occupational accidents (Wirahadikusumah, 2005). The obligation to hold safety management system at large-scale construction companies based "Labor Clause", only generating 7.1% of the more than 75,000 companies which already have implemented Safety Management System (Putranto, 2015).

Condition gets sad where there are only about 1,500 supervisors in charge to monitor the infrastructure work held by approximately 175,000 construction companies in Indonesia (Balikpapan Pos, 2015). In other words, there are very minimum numbers of companies which are seriously monitoring their safety activities. It indicates that the company does not care about occupational health and safety factors so that the work accident hard to be reduced. They have common perception that safety program would only be an additional cost burden for companies (Putranto, 2015).

In various activities of the implementation of construction projects, the most dangerous job is height work and excavation work. In both type of works, accidents that occur tend to be serious and often resulting in permanent disability and death. Usually fatal accident is caused by falling from height. This risk is less to be cared by the perpetrator of the construction, with often ignores the use of personal fall arrest system which has actually been set in the guidelines for the construction in Indonesia (Dauly, 2010).

2.4 Theory of Accident

Based on OSHAS 18001 (2007) standard, accident is incident of work-related events in which an injury or ill health regardless of severity or fatality occurred, or could have occurred. By looking at the impact from accident that it can be occurred or could have occurred, accident is divided into two types. First type of accident is an incident regarded as a particular type of incident in which an injury or illness actually occurs. The second type accident can be defined as incident where no injury or illness occurs, or called Near-Miss Accident.

Furthermore, Putranto (2015) elaborate the classification of accident into 4 categories based on ILO specification. The classification will be explained as follow:

- i. *Based on type of accident.* Based on the types of it, accident can be divided into several things namely; falling, struck and hit by object, pinched, excessive movement, high temperature effect, electric shock and contact with hazardous material.
- ii. *Based on cause of accident.* Based on the cause, accident will be classified by the these type of causes namely; Machine, conveyance, the materials, substances, and radiation, work environment and other equipment such as electrical tools, manual Tools and so on.
- iii. *Based on the nature of the injuries.* Based on the effects, accident will be divided based on several effects such: Dislocation (of bones), muscle stretch (tendon) bruises/internal injuries, surface wound, broken, burns and effect of radiation.
- iv. *Based on spot of injuries.* The spot of injuries will be divided based on human parts such; Head, neck, body, upper parts, lower parts, many parts, other parts.

2.5 Theory of Accident Causation

Accident causation theory is a model to identify the root problem of accident in construction and other industry. This approach is aiming to prevent the accident from the earliest cause (Abdelhamid and Everett, 2000). Here are some theories of accident causation made by previous researcher.

2.5.1 Domino Theory

One of major theories concerning accident causation which has some explanatory and predictive value is Heinrich Theory or also called as "Domino Theory". As shown in Figure 2.1 in the Domino Theory by Heinrich, accident consists of five interrelated factors which are: working conditions, human negligence, unsafe acts, accidents and injuries. Heinrich *et al.* (1980) came up with theory that the accident happen to the workers as a series of interrelated process. The mechanism of the accident is described as "Domino Sequence" as follows:

- i. *The Ancestry and environment.* This is derived from the people who have bad behavior (stubborn) due to hereditary factors, environmental influences and education that cause they work inadvertently resulting many mistakes
- ii. *Fault of the person.* This is a series of genetic and environmental factors mentioned above which lead to wrong actions in doing the job
- iii. *Unsafe act and mechanical or physical hazards.* Dangerous actions along with other mechanical and physical danger which result in next sequence of accident
- iv. *Accident,* Incident that occurs to the workers. Generally will cause certain losses
- v. *Injury.* Accident which resulting in injuries or severe disability and even death

These five factors are arranged like dominoes card standing in parallel. If the cards fall, then this card will befall on another card until all fifth will collapse together. This picture below will represent the series of accident factors in the theory itself.

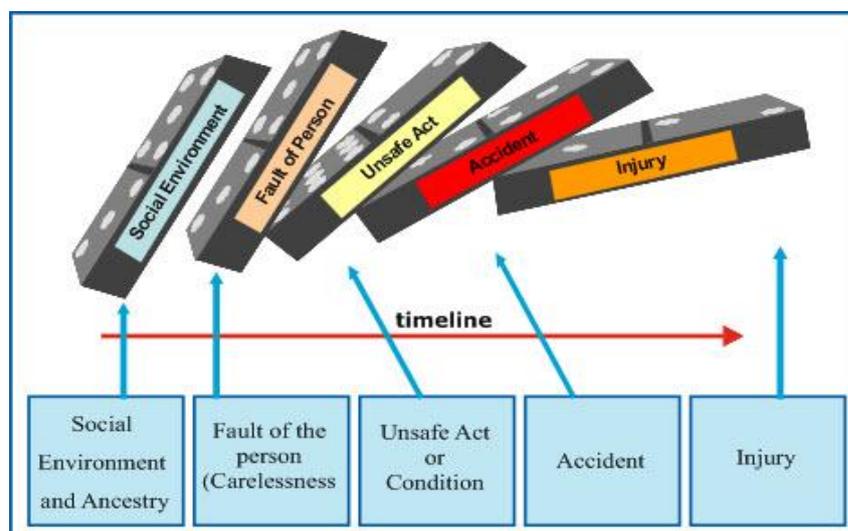


Figure 2.1: Domino Theory

2.5.2 Multiple Causation Model

This model presented by Petersen in 1971 which has a completely different concept from the domino theory that affects many researchers. This model was inspired due to believe that many contributing factors, causes and sub-causes are a major reason in the accident scenario. In this concept, factors are combine together at random and causing an accident. By using several models of multiple causes, accident factors will be revealed. The series of questions will be used to identify the root cause of the accident. For example scaffolding collapse, the question would be "why the scaffolding was not properly installed?", why supervisors allow to use the scaffolding?", did the injured person know that he suppose not to use the scaffolding?" and others question. The question asked was not only to appoint the injured person, but also for management, supervisors, and other people or departments related to the accident. The answer of these questions can be used to identify the root cause of the accident (Rahim Abdul *et. al*, 2003).

Unlike simplified theory of domino, there are causes and sub-causes when an accident happens. Through identification of these multiple contributing causes of accident, the unsafe acts and unsafe conditions should be prevented from arising. The process of multiple causation accident can be seen from figure below:

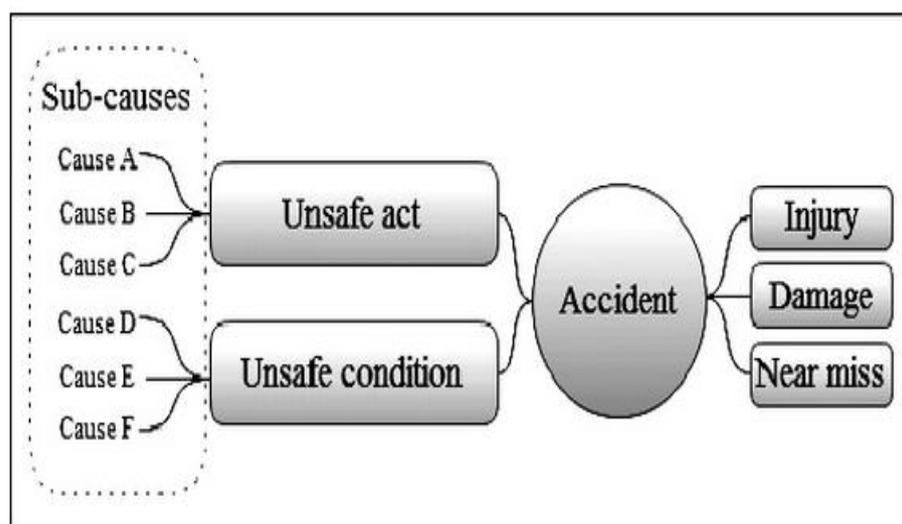


Figure 2.2: Multiple Causation Model

2.5.3 Human Error Theory

This theoretical approach refers to workers as a major factor of accident. Abdelhamid (2000) studied the human has more tendency to make mistakes in many type of conditions and situation, with the fault mainly addressed on the characteristics of a human being. James Reason made a concept of human error trapping which is known as "Swiss Cheese Model". Based on Figure 2.3, it's clear that these failures are equalized to holes in a Swiss cheese. The first level portrays those "unsafe acts" that ultimately led to the losses. This level generates the most investigation and, consequently, is the level where most causal factors are uncovered. After all, it is typically the actions or lack thereof that is directly linked to the undesirable result.

As their name suggests, hidden failures, unlike their active counterparts, may lie dormant or undetected for hours, days, weeks or even longer, until one day they badly affect the unsuspecting caregiver. Consequently, they may be overlooked by investigators even those with the best intentions. Referred to as preconditions for unsafe acts, this level involves conditions such as mental fatigue, poor communication and coordination practices, and frequent interruptions. Not surprising, if fatigued caregivers fail to communicate and coordinate their activities, poor decisions are made and errors often result (Raheja and Escano, 2011).

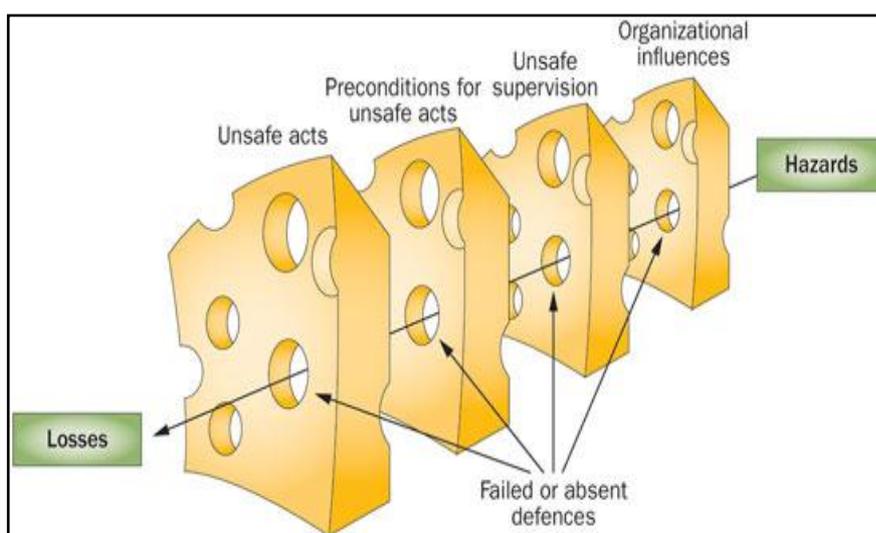


Figure 2.3: Swiss Cheese Model

On the contrast the more improvements have been achieved in technology and engineering, the more number of accidents caused by human errors are reported. Unsafe condition is represented by holes in the next slice of Reason Swiss cheese model. The unsafe condition and the psychological risk factors are the contributory factors to unsafe act of workers. Unlike active failures and immediate causes in previous slice, the holes in this slice are the hidden contributory factors of accident. The relationship between unsafe condition and unsafe act is a one-to-many interaction. Unsafe condition can lead to many hazards and unsafe acts (Hosseinian and Torghabeh, 2012).

2.6 Factor of Work Accident

Aksorn and Hadikusumo (2007) have stated that generally the work accident can be grouped into two factors, namely unsafe conditions and unsafe action. Unsafe conditions are always related to machinery, working environment, production process and the nature of work. While unsafe action is potential work accident caused by human itself.

Wirahadikusumah (2005) elaborated that various major causes of work accident on construction projects are matters related to the unique characteristics of the construction project, different work location, open area and influenced by weather, limited time of completion, dynamic and demanding high physical endurance, and many uses untrained labor. Lubega *et al.* (2000) found out the causes of accidents were mainly due to lack of awareness of safety regulations; lack of enforcement of safety regulations; poor regard for safety by people involved in construction projects; engaging incompetent personnel; non-vibrant professionalism; mechanical failure of construction machinery/equipment; physical and emotional stress; and chemical impairment.

In this research, general factors of work accident will be breakdown into several types especially in relation with the construction sites. Specifically the factors of work accident have been re-classified into 6 categories. Pipitsupaphol and Watanabe (2000) have classified the factors of work accident at construction site based on six influential factors namely; unsafe equipment, unsafe work site, unique nature of industry, unsafe method, human error and poor management. Each of these

causes will have their own sets of causes and sub-causes of accidents. Table 2.1 shows some previous studies that stress those elements can be the factors of work accident at construction site.

Table 2.1: Previous Researches on 6 Factors of Work Accident in Construction

Factors of Work Accident	Author (Year)	Problem Statement
Unsafe Equipment	Kadiri <i>et al.</i> (2014)	Out of 25 factors, poor safety equipment placed the sixth rank that contributes the highest accident in Nigerian construction site. Improper tool management such as no inspection and lack of maintenance is mainly of the source of problem.
Unsafe Work Site	Monk <i>et al.</i> (1996)	Poor site condition without proper managed housekeeping is very common factors that will increase risks of injury to workers.
Unique Nature of Industry	Pipitsupaphol and Watanabe (2000)	Unique nature of industry can be defined as unusual type of task done by the workers that require stronger physical and mental power where it can be the factor that lead to accident in work site.
Unsafe Method	Wilopo (2009)	Unsafe method at site can be happened if there is no full risk analysis for the job undertaken where some safety points are missing in work method.
Human Error	Abdelhamid and Everett (2000)	The most often human error happened at work site such as due failed to secure and warn, failed to wear personal protective equipment (PPE), operating equipment without authority and working in rush.
Poor Management	Goetsch (2005)	One of the leading causes of accidents in the workplace is the failure of management to do its part to ensure a safety and healthy work environment.

2.6.1 Unsafe Equipment

Unsafe equipment is highly fatal cause of accident. Health and Safety Executive (2013) have stated that moving equipment like machinery can cause injuries in many ways. First, people can be struck and injured by moving parts of machinery or ejected material. Parts of the body can also be drawn in or trapped between rollers, belts and pulley drives.

Workers can also be at risk if their personal protective equipment is not in good condition. Ahmad (2007) had saying worker experienced the accident due to bad condition of PPE. Company fails to provide safety equipment to the required quality. Mostly worker can be at risk due to low quality head protection, safety gloves and most critically low quality body harness (Ahmad, 2007).

A study by Kadiri *et al.* (2014) have discovered that out of 25 factors, poor safety equipment placed the sixth rank that contributes the highest accident in Nigerian construction site. Improper tool management such as no inspection and lack of maintenance is mainly of the source of problem.

Davies and Tomasin (1996) had also supported the opinion by stating that workers on site are usually uncovered to the risk of physical injury or hazard in which some of the agents to these hazards are normally in the usage of equipment such as conditions of scaffolds, electric tool, welding device, excavation and so forth

2.6.2 Unsafe Work Site

Potential hazards exist in every workplace. Several of them can be easily recognized and corrected, while others create awfully dangerous situations that might be a threat for the worker's life (Rahim *et al.*, 2003). According to U.S Department of Labour (2002), the bad work site condition can be seen from these three types of hazards. They are:

- i. *Chemical Hazards*, are present when you are exposed to any chemical preparation (solid, liquid or gas) in the workplace. Examples include: cleaning products and solvents, vapors and fumes, carbon monoxide or other gases, gasoline or other flammable materials. Those materials can potentially cause fire accident for the workers and the area itself.
- ii. *Biological Hazards*, are come from working with people, animals, infectious plant material and waste of materials. Examples include: blood or other bodily fluids, bacteria and viruses, insect bites, animal and bird droppings. This type of hazard can affect the health of the workers that can result in sickness other diseases.
- iii. *Other Hazards*, such as poor lighting, messy material, constant loud noise, and bad weather at site. Those hazards can affect working performance and surely the safety of workers.

Monk *et al.* (1996) believed that poor site conditions without proper managed housekeeping is very common factors that will increase risks of injury to workers.

2.6.3 Unique Nature of Industry

Unique nature of industry can be defined as unusual type of task done by the workers that require stronger physical and mental power (Pipitsupaphol and Watanabe, 2000). This nature of the job being undertaken can be the source factor that leads to accident in work site. According to Mulyati (2002) basically unique nature of industry can be related with these 2 types of hazard which are:

- i. *Ergonomic hazards*. This type of hazard occurs when the worker's body position or working conditions put a strain on the body. It is difficult to be aware of because workers tend not to immediately recognize the harm for health. The most common ergonomic hazards occur at work site are frequent lifting and also repetitive movement. In the short term it can lead to muscle fatigue and in the long term can cause permanent muscle and bone disorders.
- ii. *Physical hazards*. This is the most common hazards occur in most workplaces at very frequent level. This type of works requires high physical effort that sometimes can cause accident to the workers. These types of hazards entail high focus and experience. Examples include: working with exposed moving parts, working in confined space, dealing with vibrating tools, working from ladders, scaffolding or heights at very significant level (more than 30 meters).

Work overload is also one type of unique nature of job. There are some projects that will put too much work for the workers exceeding normal person capacity. This may cause in developing high stress, drop of health and lead to accident to the workers at site (Greenberg and Baron, 2003).

2.6.4 Unsafe Method

The method used in construction industry will affect worker's productivity, where it is certainly strongly relate with safety and health at work place. Unsafe method can be happened there is no full risk analysis for the job undertaken. There are some missing safety points that should be input to the working method (Wilopo, 2009).

Working without normal sequence is one of the unsafe methods. Suardi and Hari (2005) had given an argument which said that engineer might skip the job sequence because they have trouble in doing it. As the consequence, their workers

follow it afterwards and led to accident. For example in the case of wall dismantling, the workers should start dismantling it from up to down. However, due to limited tools like scaffolding and heavy equipment, they start dismantling it from down to up where it can certainly collapsed and hit them down (Suardi and Hari, 2005).

In different case of unsafe method, Dauly (2010) clarified that assign wrong equipment or wrong workers to the working method will also create problem. Misapplication of the equipment can result in different outcome where it can create unforeseen accident. Besides, assigning wrong workers to the one task is also dangerous. Workers who are not competence to do one job are forced to do because they are lack of skilled workers. This incompetency might result in worst problem such as low quality of work, loss of property or accident Dauly (2010).

Other series of unsafe method is clashing of works in one place. Ramadhani (2013) claimed that two or more work at the same place in one time is very risky. Especially working on the top of other workers can cause accident to the workers below. For example like hit by material falling, and other threat similar with that. This is can certainly be the factor of work accident.

2.6.5 Human Error

Generally, work accident is caused by human error where the cause of the crash began on the activity did not survive the man himself (Silaban, 2003). Aksorn and Hadikusumo (2007) have categorized the human error factor based on 5 types of causes. First one is laziness. Many workers are not following the sequence of the job procedure where they tend to take shortcut to finish the job quickly. For example, workers will have just used a wrong tool because they have troubled getting the correct one. This is recognizes as very potential factor of work accident

Second one is doing the work out of expertise. Some workers tend to show off by doing something they cannot actually do. This type of things still happens in many work sites. Some workers just want to demonstrate their skills to get admiration from their workmates or they forcedly perform it because no one else also capable. Working out of expertise can frequently results in accident (Aksorn and Hadikusumo, 2007).

The third cause is performing the work in exhausted condition. Worker has a tendency to force themselves working even they are tired (Aksorn and Hadikusumo, 2007). It is simply because they are eager to earn more money by working full time without taking break. In exhausted condition, workers can easily lose concentration and energy that can affect their health and at worst scenario will result in accident. ILO regulation has declared workers are only allowed to work overtime if any force major. In this case also they must have 24 hours rest in a week (International Labour Organisation, 2013).

The fourth cause is being angry. Angry or in such bad mood can lead to severe accidents because anger nearly always rules over caution. Flying off the handle at work is potentially dangerous. If the workers cannot control their anger, they will start to sweat, tremble, get knots in the stomach, or grind his/her teeth. Unresolved anger could cause distraction, proneness to accidents, anxiety, violence and rage (Aksorn and Hadikusumo, 2007).

The last one is due to the effects of using drugs and alcohol. Experimental research has shown that alcohol and drugs have a hallucinating effect on performance due to its effects on judgment, reasoning and memory. Drugs users and drinkers often experience reduced levels unawareness, a situation which could lead to decision errors and unsafe working action (Aksorn and Hadikusumo, 2007).

Abdelhamid and Everett (2000) have also conducted a more comprehensive study and found out the most often human error happened at work site such as due failed to secure and warn, failed to wear personal protective equipment (PPE), operating equipment without authority and working in rush.

2.6.6 Poor Management

Goetsch (2004) found that one of the leading causes of accidents in the workplace is the failure of management to do its part to ensure a safety and healthy work environment. In more details, poor management practices that can cause an accident can be seen from 3 aspects.

First of all is poor safety facility. Tam *et al.* (2004) did a study in China and found out that the factors of work accident were due to poor safety awareness from top leaders, lack of input resources for safety, lack of rigorous enforcement of safety

regulation, lack of organizational commitment, lack of personal protective equipment (PPE) and lack of technical guidance. Based on that, it directly implies that lack of facility from management can be the root cause of accident.

The second one is due to poor safety training. Toole (2002) also did a study in the USA and suggested that one of the causes of accidents were due to lack of proper training from management. Worker without proper training will be easy to make mistakes when performing the job. They are lack of knowledge on how to use the tools and also performing specialized work like working at height, hot work and so on. This is definitely will make them become vulnerable to accidents.

The last one is poor safety monitoring. A study from Lubega *et al.* (2000) spot out that inadequate supervision has been identified as a major factor contributing to the occurrence of accidents on construction sites, and largely results from use of incompetent personnel or mere lack of commitment. This is indicating that management failed to form good monitoring supervisor. Management did not totally aware of their supervisor capacity to monitor the safety at work and they have not been reviewing their supervising activity during construction stage.

Soehatman (2010) also agrees that besides human factors, there are other factors that disproportion of management systems such as planning, monitoring and implementation that create an accident.

2.7 Solution on Factor of Work Accident

For fulfilling the objectives of this research, there are some solutions obtained from literature review regarding factors of work accident which taken into this research. The solutions will be elaborated based on 6 categories of accident's factors that have been mentioned before. The researcher has analyzed some literature reviews that relate with those factors and come out with these following solutions.

2.7.1 Solution on Unsafe Equipment

To ensure the work equipment can be used safely, there are some requirements that should be taking care of (Health Safety Executive, 2013). The requirements are:

- i. *Suitable for use.* Make sure that work equipment is suitable for its intended purpose. Correctly selecting equipment will reduce the chances of loss, damage or injury to plant, equipment and people.
- ii. *Maintained in safe condition.* Work equipment should be maintained in a safe condition. Company needs to perform routine or preventative maintenance by checking all the components or repairing the equipment if necessary. Do not forget also to do documentation of all maintained tools.
- iii. *Periodic Inspection.* Equipment should be inspected periodically to make sure it always in good condition. Inspection must be done by person with competency. There may be circumstances where deterioration of the equipment could lead to a dangerous situation developing. Lastly, it is necessary to keep the record of inspected tools.

Additionally, Health Safety Executive (2013) had also given extra information to make perfectly safe-used tools. These are following conditions:

- i. Use fixed guards to cover the dangerous parts, whenever practicable. Use the best material for these guards. Most importantly, make sure the holes of the fixed guard are not large enough to allow access to moving parts.
- ii. If fixed guards are not practicable, use other methods such as interlock the guard so that the machine cannot start before the guard is closed and cannot be opened while the machine is still moving (trip system).
- iii. If guards cannot give full protection, use jigs, holders or push sticks if it is practicable to do so.

At last but not least it is important to provide manual guideline on how to use the equipment (Yusuf, 2010). The equipment also must be equipped by appropriate tagging whether it is safe to be used or not.

2.7.2 Solution on Unsafe Work Site

Prior to this, unsafe workplace has been classified into three types of hazards. The solutions gained will be described based on those 3 types of hazards. First step is by managing the chemical hazard. According to *Canadian Centre of Occupational Safety and Health* (n.d.), it is important that controlled products must have labels that clearly identify the product and provide hazard information about it. The label must

indicate whether a workplace MSDS is available in the workplace. When working in the area contain chemical products, make sure to remove all of the products to safe place before starting the work. If it cannot be removed, so it must be protected with temporary cover that can avoid direct contact with workers when doing the job. However, it strictly forbidden to perform hot work or any job related with fire because it is flammable products. It can potentially cause burning or even explosion in that area.

Second step is by managing the biological hazard. Biological hazard came from unhygienic or dirty working area. This type of hazard is derived from waste of organic material and infectious animal or plant. These types of hazards will slowly or quickly be the threat of worker's health. In order to avoid that, make sure working area is free of biological hazard by doing periodic cleaning. Before starting the work, make sure to identify all biological hazards spot and remove it completely. In continuation, maintain periodic cleaning to avoid all the hazards to return back (Suma'mur, 2009).

Last type of hazard to be managed is some other hazards that have been mentioned before. First of all is by providing sufficient lighting. Make sure when working at night, closed area and confined space is provided with sufficient lighting. Improper lighting design will cause interference or visual fatigue during the work. Consequently, it will disturb the working process and can lead to accident. For example there are dangerous materials at the working spot, but due to insufficient lighting those threats become invisible to the workers. At the end, it can cause injury to the workers (Grandjean, 2007).

Secondly is to dislocate messy material. Messy material at working area can be source of accident. Workers can be easily stumbled or tripped that will hurt them and cause an injury. For avoiding that, it is important to do material arrangement at work site. Sort out unimportant material to other location and place all used material in proper spot (Palupi, 2008). This will keep the working site away from threat of accident.

Consequently is to eliminate constant noise. The high intensity of noise also can cause discomfort and will gradually affect the worker's condition. It can slowly damage their hearing sense and consequently disturb their concentration that will lead to other accident. It is important to create special working area for high noise work and the workers must be equipped with ear protection. Make sure also high

noise work will not last all day. There must be scheduling for this type of work (Wulandari, 2010)

Last but not least is to stop the work when bad weather condition. The most common examples are such as rain, strong wind and expose to extreme heat. Those types of threats are natural event that cannot be avoided. So it is better to stop the work in this kind of condition especially for height work and heavy lifting work (Parker *et al.*, 2006)

2.7.3 Solution on Unique Nature of Industry

The unique nature of industry or work will closely related with ergonomic and physical hazards. In terms of ergonomic hazards, the first thing to do is make sure no forcing attitude when doing the work. When performing the work with potential ergonomic hazard such as frequent lifting or repetitive movement, make sure the body will not be experiencing a forced attitude. The workers must recognize their capacity and know when the time to stop if they have exceed their limit (Mulyati, 2002).

Second thing is by having adequate rest. National Health of Scotland (2003) mentioned that the task which requires high extra body effort such as twisting, stooping, bending and pushing must have adequate rest or recovery periods after long time of works. The workers must give a gap in between the work for letting their body rest. When their stamina is recovered, then they can continue.

Then finally is to apply regular shift. The worker who does such high intensity of job must work in shift. This shifting scheme will be very effective to avoid the drop of health. The workers with this type of job normally cannot work at sequential day. Therefore, it is important to apply shifted work time (Tayyari and Smith, 1997).

As for the physical hazards, the important aspect to avoid the hazards is by having experienced workers. Physical hazard is derived from the work with extremely high risk such as height work (above 30 meters), dealing with vibrating tools or spinning sharp object. This type of job must be done by competent worker with high experience. This worker have already adapted and knowing the approach to deal with the work. However it cannot eliminate the risks completely, but at least

REFERENCES

- Abdelhamid, T.S. and Everett, J.G. (2000) *Identifying of Root Causes of Construction Accident*. Journal of Construction Engineering and Management, ASCE, January/February 2000, pp.52 – 60.
- Academy of Occupational Health and Safety Malaysia. (n.d.) *History of OSHA*. Retrieved on October 15, 2015, from <http://osha.com.my/v2/about-us>
- Aksorn, T., and Hadikusumo, B. H. W. (2007). *The unsafe acts and the decision-to-err factors of Thai construction workers*. Journal of Construction in Developing Countries, 12(1), 1-25.
- Ahmad, A. (2007). *Keselamatan dan Kesehatan Industri*. Kuala Lumpur: Dawama Sdn. Bhd.
- Balikpapan Pos. (2015, September 5). *Angka Kecelakaan Kerja Tinggi*. Retrieved on October 29, 2015, from <http://balikpapan.prokal.co/read/news/168055-angka-kecelakaan-kerja-tinggi.html>
- Blaikie, N. (2003). *Analyzing Quantitative Data*. India: Sage Publication.
- Canadian Centre for Occupational Health and Safety. (n.d.). *WHMIS 1988 General*. Retrieved on December 2, 2015, from <http://www.ccohs.ca/oshanswers/legisl/introwhmis.html>
- Cesarini, G., Hall, G., and Kupiec, M. (2013). *Building a proactive Safety culture in the construction industry: 12 steps to a safer job site*. ACE Construction. Philadelphia, PA, 19106.

- Dauly, F. A. (2011). *Faktor-faktor yang Berhubungan dengan Kecelakaan Kerja pada Buruh Konstruksi di PT. PP (Persero) Proyek Tiffani Apartemen Kemang Jakarta Selatan*.
- Davies, V.J., and Tomasin, K. (1996). *Construction Safety Handbook (2nd Edition)*. United States of America: Thomas Telford Publishing.
- Fathoni, A. (2006). *Organisasi dan Manajemen Sumber Daya Manusia*. Jakarta: Cipta Biaga.
- Friend, M. A., and Kohn, J. P. (2014). *Fundamentals of occupational safety and health*. Bernan Press.
- Gliem, R. R., and Gliem, J. A. (2003). *Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales*. Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education.
- Goetsch, L. D. (2005). *Occupational Safety and Health*. United States of America: Pearson Prentice Hall.
- Grandjean, E. (2007). *Fitting the task to the Man. A Textbook of Occupational Ergonomis*.
- Greenberg J. and Baron A.R. (2003). *Behaviour in Organisations*. Prentice Hall, Vol. 8, pp. 188-215.
- Health and Safety Executive (2013). *Providing and using work equipment safely*. United Kingdom: HSE Books.
- Heinrich, H. W., Petersen, D. C., Roos, N. R., and Hazlett, S. (1980). *Industrial accident prevention: A safety management approach*. McGraw-Hill Companies.
- Hinze, J. (2003). *Improving Safety Performance on Large Construction Sites*. CIB Working Commission W, 99.

- Hosseinian, S.S. and Torghabeh, Z.J. (2012). *Major Theories of Construction Accident Causation Models: A Literature Review*. International Journal of Advances in Engineering and Technology, 4 (2) 53-66.
- Hucknall, M. (2015, April 28). *The Top 5 Types of Security Workplace Hazard*. Retrieved on December 4, 2015, from <https://www.get-licensed.co.uk/sia-training-blog/top-5-types-workplace-hazards-security-industry/>
- International Labour Organization, (2013). *Safety and Health at Work*. Retrieved on November 1, 2015, from <http://www.ilo.org/global/topics/safety-and-health-at-work/lang-en/index.htm>
- Kadiri, Z. O., Nden, T., Avre, G. K., Oladipo, T. O., Edom, A., Samuel, P. O., and Ananso, G. N. (2014). *Causes and Effects of Accidents on Construction Sites (A Case Study of Some Selected Construction Firms in Abuja FCT Nigeria)*. IOSR J. Mech. Civ. Eng, 11(5), 66-72.
- Kakkar, A. (2014). *Training Construction Workers for Sustainable Environment*. International Journal of Environmental Research and Development. ISSN 2249-3131 Volume 4, Number 1 (2014), pp. 21-26.
- Krejcie, R. V., and Morgan, D. W. (1970). *Determining sample size for research activities*. Educ psychol meas.
- Lubega, H., Kiggundu, B. M., and Tindiwensi, D. (2000). *An investigation into the causes of accidents in the construction industry in Uganda*. In proceedings of the 2nd International Conference on Construction in Developing Countries.
- Malhotra, N. K. and Peterson, M. (2006). *Basic Marketing Research: A Decision-Making Approach, 2nd Edition*. Sydney: Pearson Education.
- Ministry Labor and Transmigration of Indonesia (2013). *Tekan Angka Kecelakaan kerja Depnaker Gandeng Tiga Universitas dari Jatim*. Retrieved on October 15, 2015, from <http://www.depnakertrans.go.id>
- Monk, T.H. Folkard, S., and Wedderburn, A.I. (1996). *Maintaining Safety and High Performance on Shift work*. Applied Ergonomics.

- Mulyati, M. I., (2002). *Prinsip Ergonomis Dalam Produk dan Sikap Kerja*. Jakarta: Sari Kahyangan Indonesia.
- Muskat, M., Blackman, D. A., and Muskat, B. (2012). *Mixed methods: Combining expert interviews, Cross-impact analysis and scenario development*. The Electronic Journal of Business Research Methods, 10(1), 09-21.
- National Health of Scotland. (2003, April 18). *Manual Handling*. Retrieved on November 20, 2015, from <http://www.healthyworkinglives.com/advice/work-equipment/manual-handling>
- Norazman, A. M. (2007). *Academic Report Writing Updated 2nd Edition*. Malaysia: Pearson Prentice Hall.
- OHSAS 18001, (2007). *Occupational and Safety Management Systems Requirements Standard, 2007*. Retrieved on September 30, 2015, from <http://www.ohsas-18001-occupational-health-and-safety.com>
- Palupi, K. (2008). *Penerapan Budaya Kerja Jepang Di Pt. Akal Cahaya Media (Acm) Acm の 有限会社の仕事のしきたり* (Doctoral dissertation, Perpustakaan Universitas Widyatama).
- Parker, D., Lawrie, M., and Hudson, P. (2006). *A framework for understanding the development of organisational safety culture*. Safety science, 44(6), 551-562.
- Pipitsupaphol, T., and Watanabe, T. (2000). *Identification of root causes of labor accidents in the Thai construction industry*. In Proceedings of the 4th Asia Pacific Structural Engineering and Construction Conference (APSEC 2000) (pp. 13-15)
- Putranto, Y. B. K. E. (2015). *"Analisis Kondisi dan Perilaku Pekerja Konstruksi Terhadap Implementasi Sistem Keselamatan dan Kesehatan Kerja (K3) di Proyek Pembangunan Sahid Jogja Lifestyle City"*. (Doctoral dissertation, UAJY).

- Raheja, D., and Escano, M. C. (2011). *Swiss Cheese Model for investigating the causes of adverse events*. *Journal of System Safety*, 47 (6), 1-2.
- Rahim, A., Z., M., Sing, B. (2008). *Cause of Accidents at Construction Sites*. *Malaysian Journal of Civil Engineering* 20(2) : 242 - 259 (2008). .
- Sadam, C. M. (2013). *Mencegah Kecelakaan Kerja di Indonesia*. Universitas Gunadarma. *Journal of Safety*.
- Silaban, G. (2003). *Upaya Kesehatan dan Keselamatan Kerja Karyawan PT. Industri Sandang II Unit Patal Secang*. Universitas Sumatera Utara: Undergraduate Thesis.
- Simamora, H. (2006). *Manajemen Sumber Daya Manusia (Edisi 3)*. STIE YKPN: Jogjakarta.
- Soehatman, R. (2010). *Sistem Manajemen Keselamatan dan Kesehatan Kerja OHSAS 18001*. Jakarta, Dian Rakyat.
- Sriwijaya Post (2014, August 30). *Tingkat Kecelakaan Kerja di Perusahaan Indonesia Tinggi*. Retrieved on 5 November, 2015, from <http://palembang.tribunnews.com/2014/08/30/tingkat-kecelakaan-kerja-di-perusahaan-indonesia-tinggi>
- Stambor, Z. (2005). *Content Analysis*. Retrieved on December 10, 2015, from <http://psc.dss.ucdavis.edu/sommerb/sommerdemo/content/intro.htm>
- Suara Pembaharuan (2015, June 29). *Ancaman Kecelakaan Kerja di Indonesia Tinggi, Salah Siapa?* Retrieved on 7 November, 2015, from <http://bisnis.news.viva.co.id/news/read/644430-angka-kecelakaan-kerja-di-indonesia-tinggi--salah-siapa->
- Suardi, R., and Hari, W. (2005). *Sistem manajemen keselamatan dan kesehatan kerja: panduan penerapan berdasarkan OHSAS 18001 dan Permenaker 05/1996*. PPM: Lembaga Manajemen PPM.

- Suma'mur, (2001). *Keselamatan Kerja dan Pencegahan Kecelakaan*. Jakarta : PT Gunung Agung.
- Suma'mur, (2009). *Higiene Perusahaan dan Kesehatan Kerja (HIPERKES)*. Jakarta: Sagung Seto.
- Tam C.M., Zeng S.X. and Deng Z. M. (2004). *Identifying elements of poor construction safety management in China*. *Safety Science*, 42 (2004) 569–586.
- Tayyari, F. and Smith, J. L. (1997). *Occupational Ergonomics: Principles and applications (Manufacturing Systems Engineering Series)*. Springer.
- Toole, T. M. (2002). *Construction Site Safety Roles*. *Journal of Construction Engineering and Management*, ASCE, 12(3) , pp.203-210.
- U.S Department of Labour (2002). *Safety Hazards*. Retrieved on 30 September, 2015, from https://www.osha.gov/dte/grant_materials/fy10/sh-20839-10/circle_chart.pdf
- Wibowo, A. (2010). *Faktor-faktor yang Berhubungan dengan Perilaku Penggunaan Alat Pelindung Diri di Areal Pertambangan PT. Antam Tbk*. Universitas Islam Negri Syarif Hidayatullah. Undergraduate Thesis
- Wilopo, D. (2009). *Metode Konstruksi dan Alat-alat berat*. Jakarta: Penerbit Universitas Indonesia. Biaya (juta rupiah) Franky Simamora, Arief Setiawan Budi Nugroho, Akhmad Aminullah..
- Wirahadikusumah, R. D. (2007). *Tantangan Masalah Keselamatan dan Kesehatan Kerja pada Proyek Konstruksi di Indonesia*. Fakultas Teknik Sipil dan Lingkungan, Institut Teknologi Bandung (www.ftsl.itb.ac.id/...konstruksi/.../makalah-reini-d-wirahadikusumah.pdf, diakses 10 Mei 2010).
- Wodak, R. (2001) "*What CDA is about*" In: *Wodak, Ruth & Meyer, Michael (eds.) (2001) Methods of Critical Discourse Analysis*. London: Sage.

- Wulandari, D. W. (2010). *Pengendalian potensi bahaya kebisingan di area product handling sebagai upaya pencegahan penyakit akibat kerja di PT Tri Polyta Indonesia, TBK* (Doctoral dissertation, Universitas Sebelas Maret).
- Yusuf, N. (2010, October 17). *Basic Safety Training*. Retrieved on 1 December, 2015, from <https://hazwelding.wordpress.com/2010/10/17/basic-safety-training/>
- Zahanariah A. R., (2003). *Komitmen Pihak Pengurusan Terhadap Isu Keselamatan Di Tempat Kerja: Kajian di Perak Hanjoong Simen Sdn. Bhd.* Universiti Teknologi Malaysia: Undergraduate Thesis.