

**RISK ASSESSMENT OF OCCUPATIONAL
ACCIDENTS IN THE CONSTRUCTION
INDUSTRY IN THE NORTHERN REGION OF
PENINSULAR MALAYSIA**

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ACCIDENTS IN THE CONSTRUCTION
INDUSTRY IN THE NORTHERN REGION OF
PENINSULAR MALAYSIA**

by

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LIST OF SYMBOLS

dB	Decibel
f^2	Effect Size
Q^2	Predictive Relevance
R^2	Coefficient of Determination

LIST OF ABBREVIATIONS

AVE	Average Variance Extracted
CIDB	Construction Industry Development Board
CR	Composite Reliability
DOE	Department of Environment
DOSH	Department of Occupational Safety and Health
DV	Dependent Variable
GDP	Gross Domestic Product
GoF	Goodness of Fit
HTMT	Heterotrait-Monotrait Ratio
ILO	International Labor Organization
IV	Independent Variable
NIOSH	National Institute for Occupational Safety and Health
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Act
PLS	Partial Least Squares
PPE	Personal Protective Equipment
SEM	Structural Equation Modelling
SOCSSO	Social Security Organization
SPSS	Statistical Package for Social Science

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**PENILAIAN RISIKO BAGI KEMALANGAN PEKERJAAN DALAM
INDUSTRI PEMBINAAN DI WILAYAH UTARA SEMENANJUNG
MALAYSIA**

ABSTRAK

Kadar kemalangan pekerjaan dalam industri pembinaan adalah antara yang tertinggi berbanding industri lain kerana sifat yang unik dalam setiap proses yang terlibat. Oleh itu, industri ini dianggap sebagai sektor yang paling berbahaya. Objektif utama kajian ini adalah untuk mengenalpasti punca kematian dalam industri pembinaan Malaysia menggunakan data sekunder dalam jangka masa lima tahun (2013-2018). Objektif kedua adalah untuk menilai persepsi penguatkuasa terhadap faktor-faktor yang menyumbang kepada kemalangan pekerjaan dan risiko kemalangan di industri pembinaan Malaysia. Objektif terakhir kajian ini adalah untuk menganalisa hubungan antara risiko kemalangan dan penyakit pekerjaan dan penyebab kemalangan di industri pembinaan Malaysia dari perspektif penguatkuasa. Kajian ini dilakukan dengan mengagihkan borang soal selidik di kalangan pegawai OSH di wilayah utara Malaysia. Jatuh dari ketinggian (43%) mencatatkan jumlah kes kemalangan tertinggi diikuti oleh perlanggaran (34%) dan penyebab kemalangan utama adalah elemen pengurusan (58 kes) diikuti oleh elemen tempat kerja dan elemen manusia masing-masing dengan 57 kes dan 30 kes. Jatuh dari tempat tinggi ($R^2 = 0.214$; $T = 5.600$; $P = 0.000$) dan jatuh pada aras yang sama ($R^2 = 0.150$; $T = 5.061$; $P = 0.000$) mempunyai hubungan yang paling signifikan dengan faktor tempat kerja, pengurusan dan luaran. Analisa 'Structural Equation Modeling (SEM) digunakan untuk mengesahkan hubungan antara pemboleh ubah yang diperhatikan dan pemboleh ubah yang digunakan untuk menguji hipotesis.

**RISK ASSESSMENT OF OCCUPATIONAL ACCIDENTS IN THE
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ABSTRACT

Occupational accident rates in the construction industry are among the highest compared to other industries due to the unique nature of the process involved. Thus, this industry is being considered the most hazardous sector. The first objective of this research is to determine the causes of fatalities in the Malaysian construction industry using secondary data during a period of five years (2013-2018). The second objectives of this research is to determine the perception of regulators on the factors that contribute to occupational accidents and the risk of accidents in the Malaysian construction industry. The last objective of this research is to analyze the relationship between the risk of occupational accidents and illnesses and the causes of the accidents in the Malaysian construction industry from the perspective of regulators. This research was conducted by distributing a survey questionnaire among OSH regulators in the northern region of Malaysia. A total of 130 responses were received from respondents. From the analysis, falling from elevation (43%) recorded the highest number of accident cases followed by struck-by (34%) and the main accident causes were management elements (58 cases) followed by worksite and human elements with 57 cases and 30 cases respectively. Fall from elevation ($R^2= 0.214$; $T= 5.600$; $P = 0.000$) and fall at same level ($R^2= 0.150$; $T= 5.061$; $P = 0.000$) has the most significant relationship with the worksite, management and external accidents causes by using Structural Equation Modelling (SEM) analysis to validate the relationship between the observed variables and latent variables as used to test the hypothesis.

CHAPTER 1

INTRODUCTION

This chapter explains the overview of this research and highlights the problem under investigation by discussing the background of the research, problem statement, scope of research, research objectives, research hypothesis and significance of the research.

Generally, this research was structured with the body consists of introduction, literature review, methodology , the causes of Malaysian's construction fatalities in (Chapter 4), risk of occupational accidents and illnesses in Malaysian construction industry (Chapter 5) and the conclusion and recommendation in the final chapter (Chapter 6).

1.1 Research Background

The construction industry has unique and own characteristics and qualities that make it differ from other sectors. The construction is unique, future in nature, and involves extraordinary diversity of professions, specialists, and suppliers (Janipha & Ismail, 2013). The Malaysian construction industry can be divided into two groups. General construction, which includes residential, non-residential, and civil engineering construction, is one such sector. The second group is special trade works, which involves metalworking, electrical work, drainage, sewerage, sanitary work, refrigeration, and other related operations.

The construction industry has displayed voluminous growth in the past year. The Malaysian construction industry continues benefiting the country's economy with an expansion of around 6% towards 2020 and ahead (Olanrewaju & Abdul-Aziz, 2015). This sector keeps on adding value to the national Gross Domestic Product

(GDP) and has a positive impact on the development of social-economic infrastructures. It accounts for almost 4.6% of the country's GDP in 2011. Moreover, this industry is also a great source of providing job opportunities for the local and foreign people (Waris et al., 2014).

In contrast to other sectors, the construction industry has a high number of fatal and non-fatal injuries for its employees around the world. This sector often faces a variety of problems, one of which is the regular incidence of industrial injuries. The construction industry has long been considered to have the highest rate of accidents in any industry, with a five-fold rise in risk relative to other industries. When accidents occur in the construction industry, they can result in a loss of productivity, as well as increased costs, machinery damage, and material waste (Alzahrani & Emsley, 2013).

Furthermore, significant accidents and inadequate working conditions have resulted in a rise in the number of fatalities, permanent disabilities, and serious injuries among construction workers. Most construction tasks, such as working at heights, working underground, working in enclosed spaces, and handling construction machinery and hazardous material, are potentially dangerous to one's health and safety (Phoya, 2012).

Occupational safety and health have recently become a major concern in Malaysia, impacting a wide variety of industries. The proof of enormous losses and accidents caused by workplace accidents and illnesses increased as a result. According to the International Labor Organization (ILO, 2014), it is estimated that 2.3 million fatalities will occur annually due to work-related accidents and disease and a much higher number of workers who suffer from non-fatal injuries and illnesses (ILO, 2014).

Owing to the peculiar nature of its goods and the procedures involved, the construction industry has been called one of Malaysia's most hazardous industries and has been named the most convincing industry in terms of personal safety and health (Hashem et al., 2013). Every project has important characteristics such as expense, time, efficiency, and safety. Resulting in a lack of compliance with safety standards, staff and the general public have been subjected to more dangerous conditions on construction sites, resulting in a higher risk of injuries (Bhole, 2016). As a result, many human tragedies will occur, as workers' enthusiasm will fade away, the development will be interrupted, the process will be delayed, and expense, efficiency, and credibility will suffer.

Small-scale contractors are more likely to be exposed to dangerous conditions and experience more work-related accidents and illnesses than large-scale contractors. Furthermore, the lack of sufficient resources to resolve safety concerns is a contributing factor in small-scale contractor safety issues (Yusof & Misnan, 2019). Besides, financial restrictions, as well as a lack of preparation and awareness, can have a serious effect on safety practices among small-scale contractors.

In Malaysia, laws, and regulations concerning worker safety and health are fairly broad. The implementation of this law and regulation would result in a major increase not only in worker safety and health but also in worker and employer understanding of the causes of construction site injuries (Zakaria et al., 2010). After the enactment of the Occupational Safety and Health Act (OSHA) in 1994, the number of industrial injuries has decreased. In several nations, the relevant occupational safety and health authority has mandated regulation and detailed protocols for avoiding occupational accidents and illnesses.

Nowadays, the government is actively monitoring the employer's OSHA efficiency to reduce the number of workplace injuries and to continue to boost their OSHA quality. This task does not solely rely on the government; it is also dependent on the attitude of construction workers toward their safety and health. Many construction industry researchers and practitioners agree that regulations and legislation alone are inadequate to achieve the ultimate target of zero injuries and incidents on construction sites (Yakubu & Bakri, 2013).

In certain parts of the world, the construction industry remains extremely hazardous through decades of policy reform, safety studies, and safety measures (Loosemore & Malouf, 2019). Safety management is crucial in the construction industry because inadequate safety management leads to accidents, which result in injuries and project delays, as well as accident-related costs (Lai et al., 2011).

Despite of safety and health regulations implementation in every state in Malaysia, high rates of injury and fatalities persist. Referring to the Department of Occupational Safety and Health (DOSH) for accidents statistic by sector (2015), the construction sector recorded the highest fatalities rates (from the year 2007 until 2015) among the other sectors in Malaysia. This shows that, the existence of laws and regulations in Malaysia which is implemented in the construction industry still low. This unfortunate scenario has posed a major challenge to construction project efficiency and overall results, as well as the country's labor force and economy (Phoya, 2012).

The elements in contributing factors to occupational accidents and illnesses in the construction industry vary in terms of risk. The existence of various types of hazards will determine the degree of accident risk. There are two major categories of hazards (Kamal et al., 2013);

- i. the risk of physical injury or physical injury hazards – hazards that are normally associated with the process like scaffolds, ladder, roof work, plant and machinery, excavation, and others.
- ii. the risk of ill health or health hazards – health hazards in construction site may be grouped into chemical, physical, and biological hazards.

1.2 Problem Statement

Risk of occupational accidents and illnesses caused by the human, worksite, management and external elements that produce long term consequences to the workers are still high in the Malaysian construction industry. Although proper and comprehensive OSH legislation is introduced and implemented, the Malaysian construction industry is still considered high-risk and hazardous. There are a lot of previous studies that used construction workers as their respondents to evaluate the risk at the construction sites. Hence, this research focused on assessing the risk of occupational accidents and illnesses from regulators' perspectives to evaluate risks in the Malaysian construction industry.

Occupational accidents and illnesses are significant public health problems in many countries. This is generally correlated with a condition where other employees and managers are unable to monitor and manage at work. Despite its significance, the construction industry has been listed as a high-risk industry with a high rate of accidents and illnesses among construction workers.

Malaysia is also one of the countries that cannot escape this issue, according to the studies. This is because, from time to time, it has been discovered that injuries on construction sites often occur and, in some cases, escalate over time. As a result, this issue cannot be ignored in Malaysia, and it has become one of the major issues that have resulted in a rise in the number of accidents. As a result, this issue cannot be

overlooked in Malaysia, where it has become one of the most serious concerns involving the number of workplace injuries and deaths.

1.3 Scope of research

With the increase with the number of occupational accidents in the construction industry, the research focused in examining the factors that leads towards the risk of accidents in this industry. The scope of the research is restricted to select a group of regulators from Department of Safety and Health (DOSH) and Construction Industry Development Board (CIDB) were studied using a set of questionnaires. The empirical of this research is restricted to four states located in the Northern region of Peninsular Malaysia. Therefore, the scope of this research is limited to Malaysian construction industry, and more specifically to general construction, which includes residential, non-residential and civil engineering construction.

1.4 Research Objectives

- i. To identify the causes of fatalities in the Malaysian construction industry.
- ii. To determine the perception of regulators on the factors that contribute to occupational accidents and illnesses and the risk of occupational accidents and illnesses in the Malaysian construction industry.
- iii. To analyze the relationship between the risk of occupational accidents and illnesses and the contributing factors in the Malaysian construction industry from the perspective of the regulators.

1.5 Research Hypothesis

- i. Human and worksite elements are the main contributing factors towards fatal accidents in the Malaysian construction industry.

- ii. Human and worksite elements are the main causes of accidents and illnesses in the construction industry while falling is perceived as the highest risk of accidents.
- iii. There is a significant relationship between the cause and types of occupational accidents in the Malaysian construction industry.

1.6 Significance of the Research

Managing occupational safety and health aspects in the construction industry is important to scale down the rate of occupational accidents and illnesses. This aspect not only will protect the workers from accidents and illnesses, but it also can lower the medical cost, reduce turnover and absenteeism, increase workers' productivity and project quality.

Effective management of occupational safety and health in the construction industry also will be lowering the fatality rates. Proper approaches and transparent implementation can increase the success rate in reducing the rate of occupational accidents and illnesses. But, it requires commitment from all parties involved within each level of management and at every stage of construction. This is because a construction project is a long and complicated process.

This research is expected to answer the objectives that have been set, namely (i) to determine the causes of fatalities in the Malaysian construction industry; (ii) to determine the perception of regulators on the factor that contributes to occupational accidents and illnesses in the Malaysian construction industry and (iii) to analyze the relationship between the risk of occupational accidents and illness and the causes of the accidents and illnesses in the Malaysian construction industry from the perspective of regulators.

1.7 Summary

In the future, the construction industry in developed countries will face serious challenges. Malaysia's construction industry is important to the country's economy and has always played a key role in national infrastructure growth. Agriculture, forestry, fishing, mining, manufacturing, construction, and services make up Malaysia's economy. The Malaysian construction industry has contributed significantly to the country's economic growth over the last decade.

Since the construction industry in Malaysia is more dynamic and subject to greater risk than any other industry, it is crucial to select and execute appropriate risk management techniques in order for the project to succeed, and this forms the core introductory principles of risk management.

The completion of construction projects within the planned timeline has always been the most difficult challenge for construction firms, and it has been discovered that many construction projects have struggled to produce the projects on schedule, on budget, and with the standard that the clients and their contractors had expected before the project started. As a consequence, it is important for management to effectively design a course of action to fulfil the targets and expectations while preventing workplace injuries and fatalities.

The problem statements in this research are based on the factors contributing to occupational accidents and illnesses in the construction industry. The arising number of development projects and the number of accidents indicates an increasing risk factor in the construction industry.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discusses issues relating to occupational safety and health in the construction industry. This chapter also provides an overview of the types of risk and contributing factors towards occupational accidents and illnesses. Based on the literature review the risk and the contributing factors are linked into a conceptual framework as a guide in conducting this research. This research explores the relationships of risk and contributing factors of occupational accidents and illnesses in the Malaysian construction industry.

The first part of this chapter gives an introduction to the construction industry in general. The introduction of the construction industry is divided into two parts, namely the construction organization and the construction stage. This is expected to give a little insight related to the construction industry.

The second part of this chapter touches on the factors that contribute to occupational accidents and illnesses in this industry. This factor is broken down into four major elements namely human element, worksite element, management element, and lastly external element.

The last part of this chapter covers the types of high-risk accidents at construction sites including environmental aspects that lead to occupational diseases and illnesses. This high-risk accident is divided into six main risks which are fall, electrocution, struck-by, caught in between, noise and, dust.

2.2 Introduction to Construction Industry in Malaysia

The construction sector in Malaysia is important in the Malaysian economy. It plays a key role in Malaysia's process of development, industrialization, and urbanization, from developing nation status to developed nation status, as envisaged in Vision 2020 (Khan et al., 2014). Furthermore, this industry plays a vital role in the country's economic growth and expansion (Haron et al., 2018).

The Malaysian building industry is more sophisticated, modernized, and well equipped today. Using highly advanced mechanized methods, it has the ability to produce complex heavy infrastructure and skyscraper developments (Khan et al., 2014). Demand for affordable housing by the low-income group will also remain favorable, which will be supported by several Government initiatives, such as Program Perumahan Rakyat 1Malaysia (PR1MA), Rumah Idaman Rakyat, and Rumah Mesra Rakyat 1Malaysia (11th Malaysian Plan, 2020).

Other subsectors such as civil engineering and non-residential will remain robust in line with the development of major projects such as the Tun Razak Exchange, KL118 Tower, Refinery, and Petrochemical Integrated Development (RAPID), and the Pan-Borneo Highway as presented in the 11th Malaysian Plan. Furthermore, the construction industry's significance in the 10th Malaysian Plan is thought to apply to other industries (10th Malaysia Plan, 2018). Table 2.1 lists some of the contributions that have been reported.

Table 2. 1 Construction industry in others sector

Industry	Subject
Education	Expansion of trainer intake in technical and vocational institutions on the raising of 10 training institutions subsequently and improvement of 16 existing training institutions.
Infrastructure	<p>Construction grants to the private sector to build a preschool in the less developed areas outside the city.</p> <p>Construction of toll highways and power plants.</p> <p>Construction and upgrading of rural basic infrastructure (roads, water, and electricity).</p> <p>Construction of the Integrated Transport Terminal in Bandar Tasik Selatan</p> <p>Construction of the city road to reduce traffic problems in major cities.</p>
Health	Establishment of 39 new health clinics and 81 new clinics in the rural areas.
Housing	<p>Improve rural area</p> <p>Construction of adequate, quality, and affordable houses</p>

Note: Data are from (10th Malaysia Plan, 2018)

It is mandatory for all construction companies in Malaysia to register with the Construction Industry Development Board (CIDB), regardless of whether they are Bumiputera or non-Bumiputera, local or international contractors, before undertaking the tendering ability of any contractors and respective paid-up money. Table 2.2 below shows the contractor grades of registration by the CIDB based on paid-up capital and tendering capacity (Ernawati et al., 2012).

Table 2. 2 Grade registration of contractor by CIDB

Contractor grades of registration	Tendering capacity (RM)	Paid-up capital size of the company	Size of company
G7	No limit	RM 750,000.00	Large
G6	Not exceeding 10 million	RM 500,000.00	
G5	Not exceeding 5 million	RM 250,000.00	Medium
G4	Not exceeding 3 million	RM 150,000.00	
G3	Not exceeding 1 million	RM 50,000.00	Small
G2	Not exceeding 500,000	RM 25,000.00	
G1	Not exceeding 200,000	RM 5,000.00	

Note: Data are from (Ernawati et al., 2012)

According to Rwelamila (2012), the success of a project is very crucial because, through the success of these projects, the construction industry can contribute to three objectives that boost development for developing countries, namely:

- i. increase the development and expand the distribution of necessities in life such as food, shelter, health, and safety.
- ii. improving living standards through higher wages, wider job opportunities, improvements in education, and a greater emphasis on cultural and humanitarian factors that can influence the economy and society.
- iii. individuals and nations through the ability to be self-sufficient and not rely on any party.

On the contrary, the Malaysian construction industry is also known for being highly reliant on unskilled foreign workers because it is inexpensive, abundant, and highly adaptable through the construction process (Ernawati et al., 2012). Since cost and sustainability are critical issues in the industry, they rely on a low wage, low skill,

and low overhead strategy. They still lack the ability to learn and transfer new technologies into the construction process for the most part (Kamal & Flanagan, 2012).

2.3 Contributing Factors towards Occupational Accidents and Illnesses

Despite the benefits of long-term construction industry growth, many barriers to integration exist in developed countries (Durdyev et al., 2018). A disproportionate number of incidents and injuries have affected the growth of this sector, suggesting a severe situation in the construction industry. Now, it is normal to see collapsing structures, cracking highways, toppling bridges showing some down-pit situations for Malaysia's construction industry as it has left a poor impression on the public's minds. There is a pressing need to avoid project failure, especially due to inadequate project management practices in the construction industry (Haron et al., 2018).

Most occupational accidents and illnesses can be linked back to the human element, with behavior and worker skills being the primary causes (Jaafar et al., 2018). This element has been divided into four categories: human physical, experience, attitude, and behavior. The Guidelines on Occupational Safety and Health in the Construction Industry (Management) (DOSH, 2017) were created to give clients, designer and contractors practical advice on how to manage safety, health and welfare when working on projects using the construction industry's process and products as a guidelines to communicate with the risk. These guidelines are based on five keys elements which are;

- i. managing the risk by applying the risk management approach and general principles of prevention
- ii. appointing the right people and organisation at the right time

- iii. making sure everyone has the information, instruction, training and supervision the need to carry out their job in a way that secures safety and health
- iv. duty holders cooperating and communicating with each other and coordinating their work and
- v. consulting workers and engaging with them to promote and develop effective measures to secure safety, health and welfare

Whether the accidents occur or not, factors that may cause an accident physically and directly, are among the immediate causes of injuries (Gangolells et al., 2010). According to Reese & Eidson, (2006), there are three types of causes for an incident or accident:

- i. direct; when an incident or accident is investigated, energy and hazardous materials are found to be the cause of injuries or other problems at the time of contact.
- ii. indirect; since this cause includes the release of energy or hazardous substances, it may result in accidents, property damage, and equipment failure. There are two forms of indirect causes: unsafe behavior and unsafe acts.
- iii. basic; is a symptom that leads to indirect causes, and the underlying causes must be tackled to monitor safety and health issues.

Figure 2.1 shows the causes of accidents that have been described by Reese & Eidson, (2006). One of the foundations of effective safety management and an integral part of occupational health and safety (OHS) legislation is the systematic recognition of hazards in the workplace (Gangolells et al., 2010).

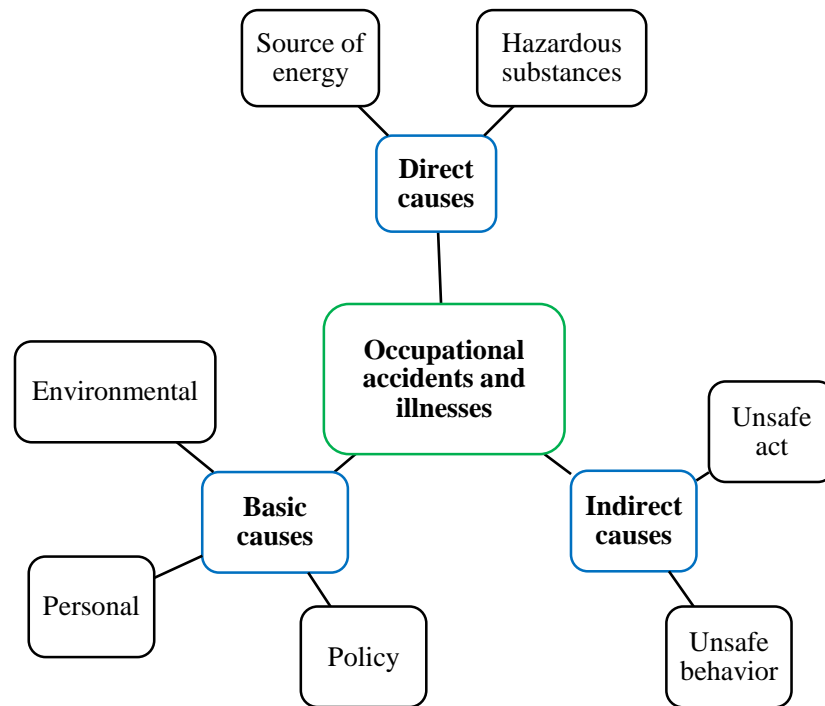


Figure 2. 1 Cause of occupational accidents and illnesses (Reese & Eidson, 2006)

Accidents are unexpected accidents that occur without any prior preparation, expectation, or control, resulting in property damage and loss as well as human injury. (Ali et al., 2010). Because of the unique nature of the sector, where workers face a higher risk of work-related fatality, construction is the most hazardous occupation (Hashem et al., 2013).

Occupational hazards, on the other hand, can be minimized by using appropriate preventive measures such as preparation, good housekeeping, threat identification, better personal protective equipment (PPE), and regular inspection (Yusof & Misnan, 2019). For accident prevention, a thorough understanding of the accident causation mechanism is essential. Theoretically, internal factors such as attitude, awareness, and performance of workers play a critical role in safety performance.

2.3.1 Human elements

In occupational accidents and illnesses, the human aspect is undeniable. Overall, it makes a big contribution. These human elements are explored in this research across four key aspects: physical influences, experience, attitude, and behavior.

Causes involving problems related to the physical and physiological elements of the human body are referred to as the human physical element (Jaafar et al., 2018). Physical symptoms, dangerous events, and physiological stress were found related to occupational accidents and job stress (Chen et al., 2017).

A research by Jaafar et al., (2018), found that workers are less aware of the possibility of injuries due to a lack of awareness, which has an effect on their decision-making as well as their evaluation of their mission. Hence, if workers are not given enough information and experience, the risk of occupational accidents and illnesses can increase.

Attitude can be characterized as a person's favorable or unfavorable emotion toward a specific action. The foundation of a person's attitude is their positive or negative evaluation of the consequences of a particular form of action, as well as their principles or understanding of the consequences (Taofeeq et al., 2019). A decision maker's belief in behavior reflects an individual attitude toward certain characteristics of behavior (Chen et al., 2016).

An unacceptable attitude could trigger the risk of occupational accidents and illnesses at the workplace. A research by Loosemore & Malouf, (2019), reveals that responsive, flexible, and immersive safety training builds a stronger emotional bond with the subject and elevates the importance of safety within trainee value systems.

Good safety training is about creating an emotional link with the subject, not just competency development (which is often the focus of safety training).

The factors that affect a person's behavior: normative values and subjective standards enforced by society, as well as significant others (e.g. the behavior of work colleagues or safety supervisors and by a behavioral intention, which represents a person's ability to take a specific action (Loosemore & Malouf, 2019).

According to Lai et al., (2011), after the introduction of safety programs, worker behaviors shift from individual safety concerns to community safety concerns, which promotes workers' engagement. This hypothesis indicates that safety behavior is related to individual and group commitment in the worksite. The primary objective of a successful safety program, according to safety experts, is to promote and change healthy conduct. One indicator for assessing safety efficiency in the construction industry is safety outcomes (Ismail et al., 2012).

2.3.2 Worksite elements

In the construction industry, the worksite factor plays a critical role in contributing to injuries and illnesses. Construction is a risky industry because of its specific characteristics, which include continuous change, poor working conditions, a transient workforce, and challenging working environments (Jaafar et al., 2018; Pinto et al., 2011). More than half of construction site injuries were caused by worksite elements. Worksite conditions, worksite arrangement, worksite equipment and materials, and worksite tasks all come under this category.

In the construction industry, worksite conditions are critical for safety and health. Worksite arrangement is an important feature that helps workers to perform their tasks safely and in good ergonomic conditions, decreasing the risk of injuries and

illnesses in the construction industry (Rodrigues et al., 2015). In a research by Jaafar et al., (2018), the most significant worksite factor in the Malaysian residential construction industry is poor site management and working conditions.

The worksite tasks are another aspect that must be considered. Workers in this industry are expected to participate in a spectrum of disciplines that expose them to safety and health hazards that are both directly linked to their job and indirectly induced by their co-workers' assignments (Pinto et al., 2011). Workers are often given several or very challenging tasks, which leads them to ignore worksite safety protocols, potentially raising the likelihood of physical injury (Abukhashabah et al., 2020).

2.3.3 Management elements

Safety management by the company or employer is crucial in creating a safety culture among construction workers. Accidents or injuries occur as a result of a lack of management attention to safety concerns, and these scenarios could be avoided by management staff (Jaafar et al., 2018). The management element, which includes policy, resource management, management culture, and safety management aspects, plays a significant role in contributing to occupational accidents and illnesses.

Having a safety policy manual a prerequisite for all contracting firms is the simplest management element to enforce, but it may not be very effective on its own (Raheem & Issa, 2016). Safety policy and objective statements, training, reviews, risk evaluations, safety obligations, and employee participation in safety concerns are all part of the safety concerns (Yusof & Misnan, 2019). Written safety policy, accident investigation, and report, safety records, safety manual, safety checklist, accident statistical analysis, and structured organizational structure are all components that should be handled by an employer (Cheng et al., 2012).

The development of human resources has a major influence on safety improvements. In addition, they reported that inadequate inspection, training, and training plan are the highest organizational level influences on injuries. These results indicate that an organization's resources are essential for a comprehensive implementation of safety (Asanka & Ranasinghe, 2015).

Procedure, preparation, information management, and supervision are all components of safety management. Construction management constraints include insufficient risk identification of undesired incidents and insufficient construction preparation in terms of the construction plan, method statement, or schedule (Jaafar, Arifin, Aiyub, Razman, Ishak, et al., 2018). Besides, extensive subcontracting, a lack of safety training, a lack of safety knowledge, inadequate safety policies and legislation, and unsupportive top management are the primary causes of high injury and fatality rates (Awwad et al., 2016).

Ownership and control concerns, workers relations, communications, worker representation, and deliberate disregard for safety are all characteristics of a management culture that contributes to OSH issues in the construction industry (Hale et al., 2012). Aside from that, poor communication and cooperation between employers and employees are said to be the causes of injuries since the majority of the workers are from different countries and do not speak the local language (Chong & Low, 2014). Safety leadership encourages team members to work harder, efficiently, and more effectively, as well as to take ownership of their safety results (Yusof & Misnan, 2019). For successful safety management, safety leadership and safety conduct were crucial. Procedures and procedures, safety codes and practices, specific priorities and resources, laws and regulations, and safety benchmarking, as well as accountability and oversight, should all be included (Ismail et al., 2012).

2.3.4 External elements

Distant causes of occupational accidents and illnesses, which are difficult to classify through accident investigations, may be considered as an external factor (Haslam et al., 2005). Politics and legislation, the economy, and social aspects are the three components that make up the external factor.

According to a previous report, regulatory factors have the ability to create a situation in which a company is able to develop successful mechanisms that contribute to healthy working conditions. To make accident avoidance possible, the government's regulation and compliance efficiency must be strengthened (Ye et al., 2018).

Regulatory enforcement is a major concern for practitioners in every field, and it necessitates in-depth technical awareness of the domain depending on the industry (Beach et al., 2015). The sufficiency of legislation and the efficacy of regulators may be associated with regulatory influences on occupational accidents and illnesses (Hale et al., 2012).

OSH implementation that is effective is assumed to minimize the number of injuries and fatalities. However, OSHA compliance in the Malaysian construction industry remains shaky due to a variety of factors, including a shortage of enforcement officers, late accident notification, failure to comply with DOSH work system requirements, and employers failing to register their companies and employees (Hamid et al., 2019).

Another component of this external factor to address is the social element. The social dimension involves the influence of the group and, in particular, clients (Jaafar, Arifin, Aiyub, Razman, Ishak, et al., 2018). The problem involving society does not place a high priority on occupational safety and health concerns in the construction

industry (Hale et al., 2012). Despite the fact that these external factors have no direct effect and are difficult to identify in the case of occupational accidents and illnesses, they do influence other components, increasing risk.

Overall the contributing factors of occupational accidents and illnesses in the construction industry have touched on four main elements namely human elements (human physical, experience, attitude, and behavior); workplace elements (workplace conditions, site layout, equipment and building materials, and task requirements); management elements (occupational safety and health policy, resource management, safety management and management culture) and external elements (political and legal, economic and social). Figure 2.2 shows the contributing factors of occupational accidents and illnesses in the construction industry adapted from (Haslam et al., 2005; Jaafar et al., 2018).

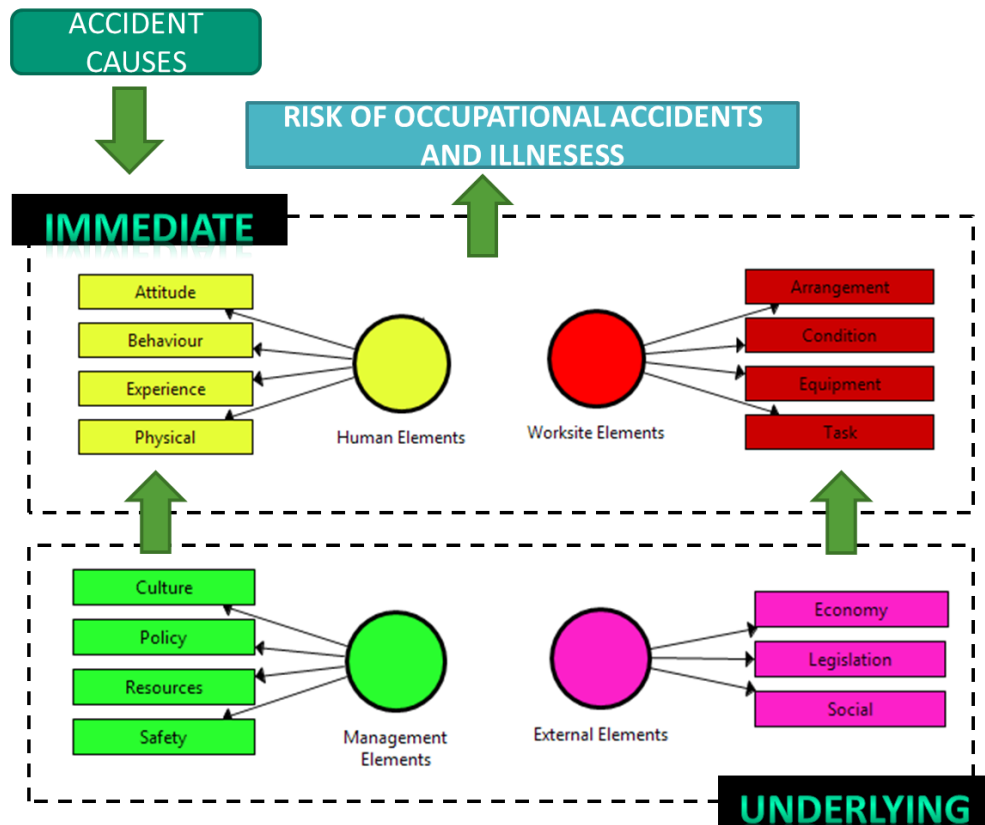


Figure 2.2 Contributing factors towards occupational accidents and illnesses (Haslam et al., 2005; Jaafar et al., 2018)

2.4 Risk of Occupational Accidents and Illnesses

Safety is always a key issue in the construction industry due to the dynamic and hazardous nature of construction sites and has been regarded by practitioners and researchers as a critical challenge to them (Lee et al., 2020). The “Fatal Four” which are falls, struck by object, electrocution, and caught in between are considered as the causes of workers died in a construction site (Albert et al., 2014).

The frequent occurrence of construction-related accidents and health issues indicates that this industry is the most dangerous occupation related to the particular nature of the industry where workers face a higher risk of work-related death (Hanapi et al., 2013). Furthermore, employees who spend their entire working lives in the construction industry have a higher chance of being killed on the job.

The prevalence of insufficient hazard identification in the construction industry is one reason for these high accident rates. Unintentional hazard exposure, accidents, and catastrophic safety events are more likely when workers fail to identify and control related safety hazards (Jeelani et al., 2017). Other than that, problems regarding the supply of services, materials, labor, and economic conditions are issues that are underlying causes of fatal accidents in the construction industry (Hale et al., 2012).

The likelihood of injury or damage intervention is linked to the Hierarchy of Control, which is one of the risk management principles. It also stated that ‘elimination’ or ‘reduction’ of risk is preferable to protecting a person through individual or behavioural controls (Abas et al., 2021).

2.4.1 Falls

Falls are problems that have a high occurrence rate in the construction industry. As the most fatal cause in the construction site, fall from height has drawn lots of researcher’s

attention. As cited by Mistikoglu et al., (2015), falling from height is one of the leading causes of fatalities and injuries in the construction industry.

A research by Zhang et al., (2015), shows some of the inefficiencies associated with manual fall hazard identification and preparation. Here are a few examples:

- i. it involves the use of qualified safety engineers who can recognize possible safety hazards and suggest suitable safety equipment based on their past experiences.
- ii. many of the safety problems are unspoken, as a consequence of partially completed conditions not shown on the building plans.
- iii. the construction project's complex design creates shifts in safety requirements. Based on static drawings, it is difficult to classify possible fall hazards at various construction stages or schedules.
- iv. the construction schedule is subject to change due to several factors such as weather and material delivery, which allows the safety plan to change.
- v. workers fall to a lower level at a leading-edge, for example, are easier to detect than smaller holes that cause foot injury. Since these holes are rare, they can go undetected even by experts.

A research by Mistikoglu et al., (2015), found that fatality occurrence in fall accidents increase along the fall distance followed by injury causes, safety training, and construction operation. According to a report by Ye et al., (2018), the most common forms of construction incidents were high-altitude falling or fall from elevation, as well as collapse. The hypothesis set for risk of falling from elevation are presented below;

Ho: Accident factors have a significant relationship with the risk of falling from elevation.

H_A: Accident factors do not have a significant relationship with the risk of falling from elevation.

The number of injuries caused by falls at the same level including slipping and tripping hazards is increasing, and their true risks have been underestimated (Hasanzadeh et al., 2018). Prior research has shown that the most common cause of falls at the same level is damage to floors, walkways, or ground surfaces, with the lower extremities and trunk being the most affected body parts (Yeoh et al., 2013). On building sites, tripping hazards are one of the most frequent occurrences.

Tripping accidents can result in a lifetime of discomfort for injured workers, in addition to the cost and loss of productivity that these injuries cause (Lim et al., 2016). The hypothesis set for risk of falling at the same level are presented below;

Ho: Accident factors have a significant relationship with the risk of falling at the same level

H_A: Accident factors do not have a significant relationship with the risk of falling at the same level.

Furthermore, the primary three causes for fall accidents are lack of complying scaffolds or protection, improper use of personal protective equipment (PPE), and bodily actions. The amount of fall protection offered, the type of fall protection system used, and whether or not the worker was a member of a union were all found to be unimportant factors in predicting the seriousness of injury (Mistikoglu et al., 2015).