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Strategies for Developing Good Safety Construction Environment–A Case Study of Risks Involved and their Management in South-East Asia

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Abstract: *The issue of occupational injuries is mostly identified among construction companies. These occupational injuries are closely related to the Occupational Safety and Health Act of 1974 (OSHA) and can result in significant financial losses for companies that violate the law. Apart from the fines and jail terms involved, companies with high occupational injuries and accident rates are also threatened with several risks, such as human and environmental resource losses. The paper aim at identifying some of the risks involved in construction industry and ways to mitigate such occurrences. Specifically it is to strategize way of enabling good safety construction environment. To study how to manage those risks, a case study was done on IJM Corporation and Yau Lee Corporation Limited, two construction industries in Malaysia and Hong Kong, respectively. Using the secondary method of study the result shows several physical and non-physical strategies, such as the establishment of a safety committee and safety policy, as well as the usage of safety equipment. The strategies being implemented brought positive impact to both companies, with obvious reduction in accidental rate per 1000 people in the next five years. Through these strategies other companies in the same industry will find the research a reference material as guide for reducing effectively the average accident rate in construction industries.*

Keywords: Construction, Injuries, Safety, Risk management

1.0 INTRODUCTION

Risk is a usual thing in daily life but its management is most important in all aspect of endeavor. The construction industry presents serious danger and risks like other occupations like; health practitioner, the mechanic, the pilot, even the driver. However, the construction industry occupies an integral part of a nation's life as it contributes immensely to its growth and economic development. The industry is engaged in building of infrastructure such as accommodation, shops, bridges, equipment, offices, hospitals, schools, and roads (Ashworth & Pereira, 2018). The quality and safety of infrastructure and other physical facilities in a country epitomize the degree of a country's success. Thus there is a close relationship between the construction industry and the economic development of a country. A lot of approaches are applied by construction companies globally towards safety issues, Asian countries are thus not left behind among such nations. However, most of them only focus on improving the physical working conditions while safety management system or procedure which limits their safety performance are begging for improvement. There are many companies still actively searching for better ways to improve their safety performance, they made it of significant concern despite the high occupational injuries in the workplace (Morton, 2020).

Advances and complexities in the construction industry are major reasons that have led to the rise in risk and hazards among construction industry workers most of which are related to fatal and nonfatal injuries. Minimizing this kind of risk in the construction industry is difficult because of its labor-intensive nature and the frequent changes in the activities of the workers. The situation is worse following the behavior and the negative attitude of workers towards safety. With the advent of technology, construction workers are required to do more jobs to fulfill the increasing demand for their services. The construction job needs to be completed within the period stated in the contract. This can be the cause of the increasing occupational injuries in the construction industry because of pressure on the workers. A global comparison of the fatal accidents for various industries can be seen in Figure 1, a chart plotted based on the data source from the Department of Safety and Health.

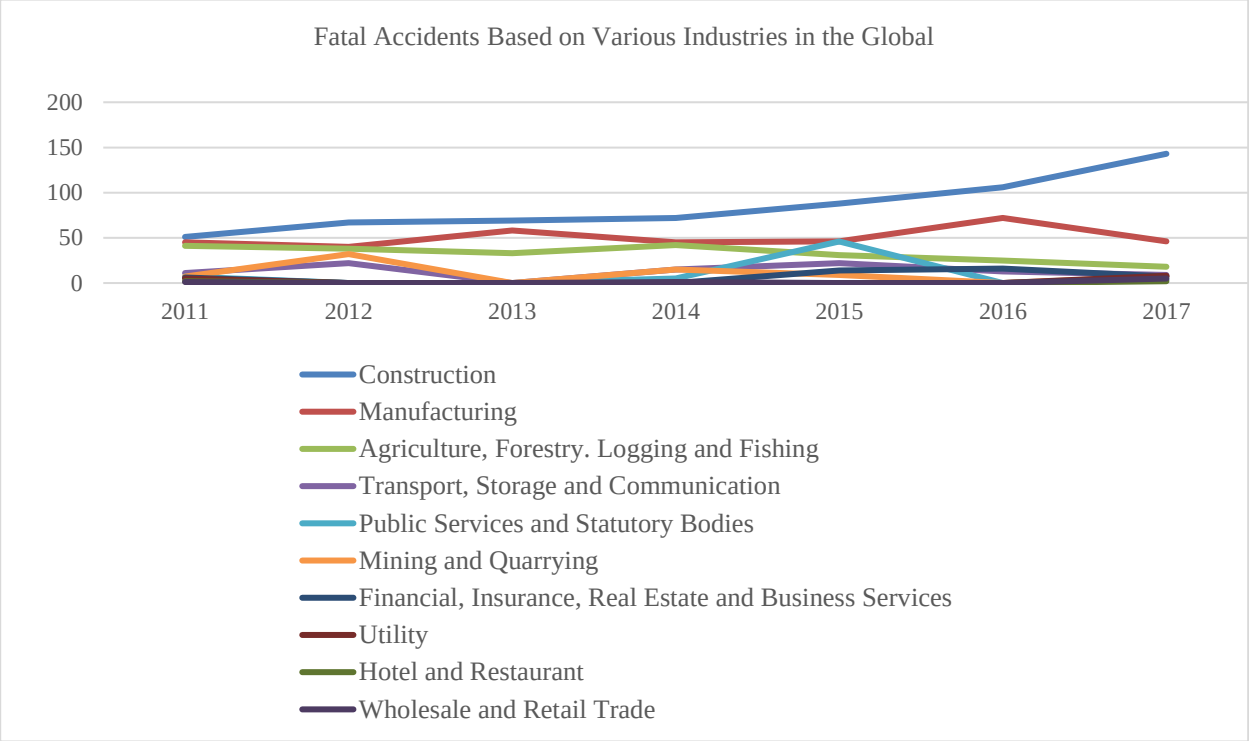

Figure 1: The Comparison of the Fatal Accidents for Various Injuries from 2011 to 2017
(Source: Department of Safety and Health, 2018)

Based on Figure 1, we can observe that the number of fatal accidents for the construction industry is the highest among the industries in the survey. The chart plot on it is above the charts of the other industries in the world. Whereas, in the construction industry the number of accidents and fatal cases can be viewed in Figure 2;

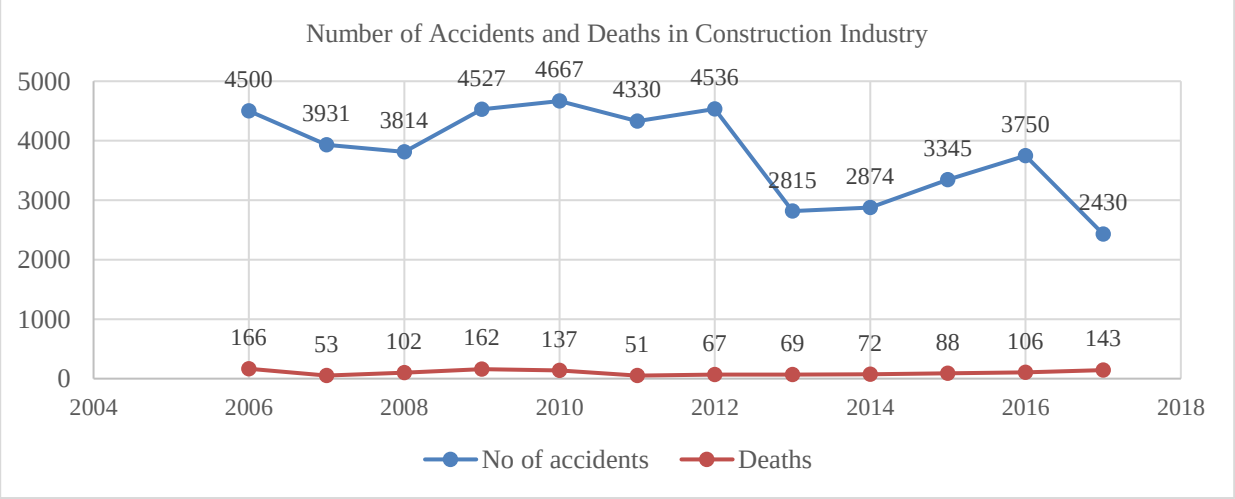

Figure 2: Number of Accidents and Fatal Cases in the Construction Industry from 2006 to 2017
(Source: Department of Safety and Health, 2018)

Based on Figure 2, the number of accidents for employees in the construction industry seems to fluctuate. The number in 2017 is far smaller compared to 2006. However, looking into the number of fatal cases, the number of deaths increases, especially in the nearest five years. In Malaysia, the construction industry is one of the major contributors to the economy (Hamid et al., 2018). It is labor-oriented and involves a lot of employees. According to the findings of a study conducted by Manu P. et al., (2018) on the management of health and safety (H&S) in the context of Vietnam, Malaysia, and Thailand are exposed to high hazards while executing their job duties on construction sites. In many nations, construction accidents that results into injury, illness in workers and the public and

even death are prevalent as identified by such scholars like; (Chellappa, V et al., 2021; Takala et al., 2014; Kifle, M. et al., 2014). Lingard et al., (2010) identified that approximately 46 compensated fatalities occur annually in Australia, while 21% of occupational deaths in the USA are from construction. Victims, their families, employers, industry, governments, and society bear the high consequences of these tragedies. In the UK, construction-related injuries and illnesses cost about £1.1 billion annually (HSE, 2014). The US Bureau of Labour Statistics reported US$11.5 billion in non-fatal and fatal construction injuries in 2002 (Waehrer et al., 2007). Rising and emerging nations (middle income and low-income economies) have a higher rate of building accidents and fatalities than industrialized nations. In 2007/2008, 162 South Africans (excluding motor-vehicle accidents) died (CIDB, 2008), while 72 UK workers died (HSE, 2015). Over 70% growth in global construction output to US$15 trillion by 2025 (worldwide Construction Perspective and Oxford Economics, 2013) could impair emerging economy health and safety without effective controls. Reducing workplace accidents, injuries, and diseases requires effective health and safety management.

Global occupational accident estimates by Hämäläinen et al., (2006) indicate higher fatality rates in Cambodia, Malaysia, and Vietnam (28.3, 18.3, and 27.0 per 100,000 workers) compared to lower rates in countries like the UK, Malta, France, Australia, Japan, and Germany (0.8, 3.0, and 3.2 per 100,000 workers, respectively). Occupational accidents, injuries, and deaths in Southeast Asian construction are prevalent. In Malaysia, the construction sector had the largest number of occupational fatalities in 2015 (88 out of 214) (Department of Occupational Health and Safety (DOSH, 2015). In 2015, Singapore had fewer fatalities, however the construction sector had the highest number of occupational fatalities (27 out of 66) (Ministry of Manpower, 2015). The construction industry in Vietnam caused 31% of the 627 industrial fatalities in 2013, according to MOLISA (2014). Construction, machine installation, and water-well digging caused 155,000 accidents and infections in Thailand from 2003 to 2011 (Occupational Safety and Health Bureau, 2012).

As observed by Fem et al. (2021), given the outlook of construction health and safety management performance in Southeast Asia, the forecasted growth in construction, and the importance of H&S management to reducing accidents, injuries, and diseases, an inquiry into contractors' health and safety management practices in Vietnam, Cambodia, and Malaysia is timely and relevant to the extent of flagging lagging areas and practices. There is little extensive research on contractor H&S management in Northern and Southern Vietnam, despite preliminary research by Nguyen et al. (2015) and Phung et al. (2015). While research on contractor H&S management methods exist, their domains vary (e.g., Cheni et al., (2008) in Ghana and Agumba et al., (2014) in South Africa). Lingard and Rowlinson (2005) suggest that implementing an H&S management system is crucial for systematic management inside an organization. ILO defines H&S management system (HSMS) as a set of interrelated aspects establishing OSH policies and objectives, and achieving them (ILO, 2001, p.19). According to HSE (2013), an HSMS is a formal framework for managing health and safety, while Griffith and Howarth (2001) define it as a method of doing things. HSMS is a system of practices to produce a safe workplace. The development of HSMS in the 1990s (Hasle and Zwetsloot, 2011) and Lingard and Rowlinson (2005) indicate that early efforts to minimize negative health and safety consequences focused on safe physical environments. The same authors emphasize the importance of workplace organizational variables, including H&S management activities, in occupational health and safety has led to systematic management of H&S in the workplace. The literature is full of HSMSs, but this section highlights some of the most notable. It also shows H&S management system interface with quality and environment management systems. The review identifies elements/practices, rather than determining the most effective system(s), while acknowledging prevalent arguments (Pérezgonzález, 2005). In the 1990s, rules (e.g. EU framework directive) and models (e.g. BS OHSAS 18001) required systematic H&S management (Hasle and Zwetsloot, 2011). But reducing accidents and their harm has spurred their development. The HSE (1997), HSE (2013), BSI (2007), and ILO (2001) health and safety management models are examples.

At the moment, there are quite a few studies carried out on the safety behavior of employees in the construction industry. Johari. et al, (2017) suggest that further studies needs to be undertaken on the construction industry to determine safety behavior of the roles of safety climate, safety communication, and work environment towards safety behavior in manufacturing industry. The primary objective of this study is to address the existing knowledge gap in construction safety management by examining the risks and management solutions within the Asian setting. The utilization of the case study approach will yield comprehensive understanding of the obstacles and effective strategies, so providing pragmatic direction for enhancing safety results in the construction sector of Asia. This paper specifically aims to analyze the integration between organizational systems or procedures and human-value systems to come up with strategies to develop a good and safe construction environment for Asia. In Section 2, strategies used to handle the issue of the accident in the construction industry in other cases will be explained with the appropriate methods to analyze this issue. In Section 3, the methods used for the whole study will be explained with the background of the companies being the subjects of the case study. Meanwhile, in Section 4, risk identification will be done based on the two companies in the study. Section 5 will be about the analysis of the methods being used by the two companies in this study to handle the accident issue in the construction industry. In the last section, conclusions and recommendations will be made.

2.0 LITERATURE REVIEW

Literature on safety practices in the construction industry highlights the significance of various factors in ensuring a secure working environment. The significance of management commitment, safety policies, resources, training, and supervisor commitment as key indicators of safety climate has been advocated by scholars (Melagoda & Rowlinson, 2022). Additionally, the implementation of safety management practices is crucial for reducing accidents and promoting safety in construction projects (Ishak et al., 2022). Coordination and commitment at all levels of the construction workforce are essential for the success of safety programs and overcoming execution challenges (Al-Kasasbeh et al., 2022).

2.1 Compliance with the Occupational Health and Safety Act (OSHA)

The literature on safety practices in the construction industry highlights various critical aspects that influence occupational health and safety (Hagan et al., 2021). The authors emphasize the importance of collective mindful and safety climate indicators in fostering a safe working environment. They stressed the significance of implementing safety management practices to mitigate accidents. They also underscore the necessity of coordination and commitment across all levels of the construction workforce for successful safety programs. Furthermore by exploring the role of emerging technologies in enhancing safety benefits and challenges of cloud computing in the construction sector advocate for integrating safety management frameworks into construction operations to reduce accidents and injuries. Highlight the positive impact of regulatory efforts on construction safety records stress the importance of objectively evaluating accident prevention costs to address high accident rates. Lastly, the study underscores the need for tight control of safety issues in construction to ensure worker safety and sustainable enterprise development.

Azil and Jabar (2022) highlighted the critical role of safety teams in managing safety practices within the Malaysian construction industry. Safety practices are predominantly the responsibility of safety teams, distinguishing their role from other entities involved in construction project management. This underscores the specialized focus and expertise required to ensure the implementation and enforcement of safety protocols in construction projects. The study sheds light on the challenges and issues faced by safety teams in upholding safety standards, emphasizing the importance of knowledge management within this context.

Integrating safety management frameworks into construction operations is crucial for minimizing accidents and injuries (Singh et al., 2021). Regulatory bodies and engineering-construction firms' efforts have positively impacted construction safety records (Senouci et al., 2021). Objectively evaluating accident prevention costs is crucial for addressing high accident rates in the industry (Lee et al., 2022). Furthermore, the classification and control of safety production risks are essential for ensuring the safety of construction workers and the sustainable development of construction enterprises (Classified Management and Control of Construction Safety Production Risks, 2022). The study aims to identify obstacles to implementing construction safety, factors contributing to accidents, and the impact of safety practices on reducing workplace incidents (Mohamed & Addow, 2022). This review underscores the importance of a comprehensive approach encompassing management commitment, technological advancements, regulatory compliance, and cost evaluation to enhance safety practices in the construction industry and create a secure working environment for all involved. In 1994, OSHA was introduced. However, serious accidents still happen in the construction industry. Safety behaviors that indirectly cause accidents in the industry become the main issue to be discussed in most organizations (Hassan et al., 2018). This is because the construction industry is labor-oriented and involves a lot of workers. This makes the workers vulnerable to the risks on the construction site such as the risk of electric shock, exposure to moving objects, chemicals, dust, noise, and limited space (Purohit et al., 2018). The main objective of establishing OSHA is to mitigate the impact of the risks on the construction site and ensure safety, health as well as welfare protection from high-risk activities. Although countries have their occupational health and safety policies, they are mostly not well enforced by the authorities.

2.2 Safety Culture Promotion

Accordingly, Health and Safety Commission (1993), defined safety culture as the product of; values, attitudes, perceptions, competencies, and patterns of behavior belonging to people that determine the commitment and the proficiency of an organization's health and safety management. This definition comes from the Advisory Committee on the Safety of Nuclear Installations (ACSNI), which is an umbrella organization that oversees the safety of nuclear installations. Meanwhile, Turner et al (1989) (cited in Cooper, 2002) on the other hand defined it as beliefs, customs, attitudes, roles, as well as social and technical practices that aim to minimize the risk to employees, managers, customers, and the public to injuries and the conditions that are considered dangerous (Cooper, 2002). These definitions are quite similar in the way that they would like to vary the depth of people's thinking way and their behavior toward safety (Health and Safety Commission, 1993; Cooper, 2002. Jeelani et al, 2020).

Having a safety culture is not enough to handle the issue of labor safety in the construction industry. According to Osborn et al. (1993), a good safety culture occurs when workers have a particular attitude and belief pattern towards safety practices. They are alert to uncertainties and request assistance when they encounter unfamiliar hazards. Workers always attempt to find and use available information that would improve safety performance. Meanwhile, the organization gives rewards to the individuals who pay attention to safety problems. The management is also innovative in locating and assessing the hazards. The mechanism of having

good safety culture collects safety-related information, evaluates safety performance, and bonds people to learn safer ways to work (Ostrom, Wilhelment, & Kaplan, 1993).

Earlier in 1975, Fishbein and Ajzen described the theory of reasoned action as a construct to modify the behavior in the organization. To change behavior, it is crucial to take the role of behavioral intentions and behavioral beliefs into consideration in building attitudes. The researchers also explained individual beliefs that are approved or disapproved of by specific individuals or groups of certain behavior as subjective norms. This model focuses on attitudes and subjective norms, which are the two determinants that shape behavioral intention. This leads to the actual behavior of humans (Fishbein & Ajzen, 1975). The theory of planned behaviour, extended from the theory of reasoned action, added perceived behavioral control as the additional determinant. In 2005, Lingard and Rowlinson found that experience and anticipated obstacles affected a person's perception of their control over certain behaviour (Namian et al., 2016; Lingard & Rowlinson, 2005). These prove that changing human behavior requires them to change their attitudes and beliefs.

Organizational safety procedures have a close relationship with workers, equipment, tasks, and environmental operations. Safety climate is defined as a perception that workers share the safety interests provided and derived from the concept of the organizational climate. A good safety climate within the organization needs to be supported strongly and requires a commitment to safety from the whole organization. When workers demonstrated safety behavior, they are said to be in a positive safety climate environment. This is due to the assumption that their efforts are important. The management will be also more committed and supportive of the safety aspects of the organization. Otherwise, when management does not care about safety practices, workers might have different perceptions and attitudes towards safety. For instance, to ensure that the work can be completed sooner, they will emphasize their working speed and neglect the work safety aspects. This led to safety behaviour issues (Paap, 2018) that increase the injury risk when there is insufficient positive reinforcement, such as the lack of safety awareness from supervisors or co-workers to promote working safety behaviour (Pek et al., 2017). In the realm of construction safety, shed light on the impact of organizational safety climate factors on offsite manufacturing safety performance. Their findings challenge conventional construction practices by revealing that managers exert a more significant influence on safety performance compared to supervisors. This underscores the pivotal role of management commitment in shaping safety outcomes within the construction industry, emphasizing the need for robust safety policies and practices at the organizational level to enhance overall safety performance (Vithanage et al., 2022).

In the organizational context, the working environment or safety climate impacted safety attitude and behavior negatively. The context includes the safety and supportive work environment, as well as the working equipment and materials. Most of the time, workers are under work pressure. This could slow down the improvement from the safe direction. Workers complete their work carelessly, leading to more errors and causing workplace accidents (Nayak & Waterson, 2017). Al-Bayati (2021)'s study emphasizes the significant impact of construction safety culture on the broader workplace culture, shedding light on the pivotal role that safety practices play in shaping behavior and motivation within construction sites (Al-Bayati, 2021). This underscores the interconnectedness between safety culture, safety behavior, and safety motivation, emphasizing the need for a robust safety framework to ensure a secure working environment in the construction industry. By recognizing the influence of safety culture and climate, organizations can proactively enhance safety practices and foster a culture of safety consciousness among workers, ultimately reducing accidents and promoting a safer work environment. Following various limitations in the workplace, to obtain short-term benefits, such as work being completed faster, not complying with the safety requirements is considered the best alternative. As a result, more accidents occur at the workplace (Nayak & Waterson, 2017).

Safety communication is also associated with safety behavioural issues as suggested by Johari et al. (2017). This contributes to the overall success of an organization (Johari et al., 2017). As technology changes dynamically, with external and internal pressures, employers need to regularly monitor the effectiveness of their employees' communication. Safety communication covers a broad spectrum of work communication beginning from the entry-level to the board of directors. Different communication modes need to be used in different working conditions (Wilamowski & Irwin, 2018). Effective communication with clear objectives will help safe behavior practices among the employees. At the same time, workers will also engage with safety behavior issues in the workplace.

2.3 Integration of OSHA and Safety Culture

Al-Bayati (2021)'s study emphasizes the significant impact of construction safety culture on the broader workplace culture, shedding light on the pivotal role that safety practices play in shaping behavior and motivation within construction sites (Al-Bayati, 2021). This underscores the interconnectedness between safety culture, safety behavior, and safety motivation, emphasizing the need for a robust safety framework to ensure a secure working environment in the construction industry. By recognizing the influence of safety culture and climate, organizations can proactively enhance safety practices and foster a culture of safety consciousness among workers, ultimately reducing accidents and promoting a safer work environment. To promote safety in the workplace, workers need to have the right belief, attitudes, and behavior to perform well in the safety aspect. Sacks et al. (2013) and Lingard and Yesilyurt (2005) contend that occupational safety and health (OSH) well-managed companies typically look heavily on the importance of OSH, as well as share and convey it to all employees and sub-contractors (Namian et al. 2016; Lingard & Rowlinson, 2005). They

added that to ensure consistent good OSH performance, a shared mental model of OSH is needed. To create the model in construction, factors that affect workers' attitudes towards safety need to be understood. It is crucial to explore the human potential in safety to build a culture where safety is important in every activity. In shaping safety culture among employees, it is important to shape their perceptions and beliefs towards safety to the finest so that attitudes and behavior relative to safety can be the common right attitudes and perceptions. The working situation or environment should be also taken into account when improving the safety culture.

To understand safety culture, the focus needs to be put on understanding attitude and behavioral change. An OSH mental model consists of four elements including belief about the job, job attitude, behavioral intentions, and the actual behavior towards safety (Hou et al., 2017; Lingard & Rowlinson, 2005). Belief in safety is related to the perspective of a worker's work. For example, a worker can believe that their job is fundamentally dangerous, exciting, or probably dangerous which is related to how they think about their work. The belief depends on individuals and affects their attitudes. Individuals who believe their job to be inherently dangerous may behave negatively towards OSH rules and regulations. An unfavorable attitude toward OSH leads to an undesirable behavioral form. This is named behavioral intention. Fishbein and Ajzen (1975) explained that behavioral intentions can transform into actual job behavior. For instance, unsafe acts and risk-taking behavior occur among the workers (Fishbein & Ajzen, 1975). Lingard and Rowlinson's (2005) model also explained that negative OSH attitudes lead to unsafe behavior among workers. The relationship between belief and attitudes to actual behavior is important to be studied in the OSH performance improvement through attitudinal change.

3.0 Methodology

This section explains the research method and the background of the subjects of the case study as the information source for the study.

3.1 Methods of the Study

Critical review of existing works is employed as sources of secondary data which this research utilizes for acquiring information to analyze the strategies to overcome the construction industry's injury problem. The review is supported by the brief analysis of the data available to look into the impact and the future outlook of the injury cases in the two companies selected as the subjects of this study. The secondary data materials are selected in such a way that they are the ones that analyze the subjects of the case study used in this paper. The paper reviews the company's profiles, implementation plans, and lessons learned from initiatives by grouping similar items into one before the review is done.

3.2 Study Information Source

The two companies that are the subjects of the case study are the IJM Corporation from Malaysia and Yau Lee Construction Company Limited from Hong Kong. Both are companies in the construction industry. The reason for selecting both companies is that they are among the leading construction companies in their respective countries.

3.2.1 IJM Corporation

IJM Corporation is among the Malaysian largest construction companies. It was started in 1984 when three domestic construction companies, IGB Construction Sdn. Bhd., Jurutama Sdn. Bhd., and Mudajaya Sdn. Bhd. were merged to compete more effectively against foreign companies. It has grown in reputation and renown internationally. The company fosters a culture in which employees seek workplace-incidents-free. The safety programs aim to provide necessary skills and empowerment to all level employees in maintaining the highest health and safety standards. IJM's motto "Health, Safety, and Environment is everyone's Responsibility" has been the guiding principle to inculcate high level occupational safety, health, and environmental practice into its group work culture. IJM Corporation Berhad and IJM Construction Sdn. Bhd. are also the first construction company group in Malaysia certified with OHSAS by SIRIM in November 2000.

3.2.2 Yau Lee Corporation Limited (YLC)

Yau Lee Construction Company Limited is a project construction and renovation company established in 1958. As a result of the company's age long experience, highly endowed personnel, effective organizational scheme, advanced information system and high technologically innovative building ability, it became one of the leading construction companies in Hong Kong. Like IJM, the company also fosters the same safety culture. Yau Lee's motto "Zero Accident Policy" guides all employees to inculcate high level of occupational safety, health, and environmental practice into their work culture. The commitment of Yau Lee Company to the promotion of work place health and safety cannot be over-emphasized. Building an appropriate working environment for the workers and their business partners is a priority. Therefore the central aim is to avoid accident at all cost.

4.0 Results

4.1Risk identification

Some risks can be identified either within IJM, Yau Lee, or both. The risks cover everything from the company itself to the employees.

4.2 Human Resource Loss Exposure

In both IJM and Yau Lee, human resources are the main assets since they are both labor-oriented companies, just like the other construction companies. Hence, human resource loss exposure becomes the main risk for them as the number of occupational injuries or accidents increases. In IJM, occupational injuries and occupational health hazards have become their main concerns (IJM annual report, 2019). This happens when they carry out business activities. Apart from the injuries, occupational illnesses, for various reasons, also become their main concern when thinking of ways to reduce occupational accidents. Similar to IJM, Yau Lee also faces the issue of occupational illnesses. Occupational illness is caused primarily by excessive physical labour and potential hazards such as working at a height and heat stroke from prolonged exposure to the sun (Yau Lee Group -Annual report, 2019). Some of the injuries are caused by moving vehicles. According to Yau Lee, exposure to human resource loss can also be caused by poisonous gas leakage from the ground. The human resources loss exposure can cause millions of dollars of loss since when employees cannot work or lose the ability to work, the construction projects may be delayed, and the companies need to pay a large number of fees due to the break of a contract with the customers.

4.3 Exposure to Environmental Loss

IJM's environmental pollution has become one of the main concerns of IJM along with its business activities (IJM annual report, 2019). This is to obey OSHA since it will be sued under the act if it fails to abide by the law. The loss exposure is derived in the form of the shutdown of companies because it is against the law and the penalty it needs to pay to the government and affected parties. This is to ensure the quality of the environment so that its business can keep growing without causing effects on the other parties, as construction needs land resources to carry on.

5.0 DISCUSSION

5.1Risk-Management Strategies Identified

This section focuses on the various implemented plans by the companies to handle the risks that they encountered. The effect will also be talked about so that you can compare how things were before and after the strategies were put in place.

5.1.2 Risk Management Strategies

The strategies implemented are different from the physical to the non-physical aspects. Each strategy is meant to improve the way the companies are doing now and protect them from possible risks.

5.1.3 Physical Strategies

In IJM, various committees and practices are set up physically to emphasize safety and health in the workplace and control the risks. The first committee formed was the Occupational Health and Safety Management Committee (OHSMC) headed by IJM's Chief Executive Officer and Managing Director which consists of operating unit senior managers and the Safety and Health Committee representatives. A periodic review is done by the OSHMC on workplace occupational safety and health practices. The Safety and Health Committee (SHC) is formed at the Head Office. It is responsible for every project in the company. This committee is built to assist the development of safety and health rules as well as the working system, review the existing safety and health program effectiveness, investigate the trends of accidents as well as hazards and recommend prompt corrective action as well as review the safety and health policies at the workplace. SHC also makes recommendations to the management for any practices that are not aligned with the established policies, inspects worksites regularly, and meets at least once monthly to suggest and emphasize potential actions to improve the existing safety and health practices.

Apart from SHC, the Safety and Health Department (SHD) endorsed by OHSMC was also formed to formulate the Occupational Health and Safety Manual and Procedure. The safety manual is distributed to all project sites and the respective in-charge department. SHD conducts safety audits covering all active ongoing and starting projects. Necessary corrective and preventive actions are recommended. Prompt action is also taken to minimize identified weaknesses and deficiencies. Every construction project has to make and implement its respective Project Safety and Health plan to ensure that the company operations adhere fully to the Occupational Safety and Health Act, 1994. Finally, IJM also develops the IJM Health, and Safety Assessment System (IHSAS) based on the OHSAS 18001 standards and the relevant applicable laws such as the Occupational Safety and Health Act, 1994 and

The Factories and Machineries Act, 1967 to enhance the safety aspects of all the activities. The assessment system of procedures and testing methods of IHSAS is self-regulated. The established standards are for the various safety aspects of construction work undertaken.

On the other hand, to ensure health and safety, Yau Lee group has come up with a comprehensive plan. The Company upheld the power innovation as key towards enhancing safety. The group has developed some state-of-the-art tools to support and augment their safety procedures on site. Firstly, it introduced a robotic chlorine gas detector to protect workers and supervisors from any danger. The robot is automated to detect chlorine gas leakage. It has the capacity to move through hazard area and analyze gas concentration without human involvement. This saves the individual inspector or worker from direct contact with danger.

Equally significant is the introduction of an automatic temperature-modulated PVC conduit bender. This is paramount as it helps to bend PVC conduit to a certain angle which desire certain amount of physical strength. Thus, this development saves the worker from excessive use of strength while quality and quantity are improved upon. Finally, Yau Lee introduced "Site Remote Carwash Bay". This is to save workers from the incessant dangers associated with the traditional manual washing of vehicles whereby accidents occur due to movement of trucks especially when they squat. By these innovations it is hoped that to a large extent some of the common accidents can be avoided.

5.1.4 Non-physical Strategies

Safety policy implementation is among the non-physical strategies implemented by both IJM and Yau Lee. The IJM Corporation performs its operation with the commitment that it is environmentally responsible. At the same time, it pursues safe and healthy work practices excellently. The motto 'Health, Safety, and Environment is Everyone Responsibility' guides IJM in creating environmental awareness as well as practicing a high level of occupational safety and health in its work culture. Efforts are continually made to create awareness among the employees and employers of the collective responsibility to prevent injuries and occupational health hazards as well as ensure public safety while conducting their business activities.

IJM continually strives to prevent incidents and injuries by focusing on its systems and processes' safety while conducting its business activities. It continually improves its environmental, safety, and health practices to achieve a healthy work environment as well as prevent accidents, occupational illness, and environmental pollution. IJM's policy complies with all the applicable safety, health, and environmental legislation as well as the occupational health and safety requirements. It also provides training, information, and facilities to the employees and the related parties so that they are aware and familiar with all levels of the organization. IJM also monitors and regularly reviews the set objectives and its achievement.

The number one priority of Yau Lee Company is safety. Based on the international OHSAS 18001 Standards the company provides an occupational health and safety management system to protect the staff, contractors, and everyone in the community. Furthermore, the company has health and safety policy with collection of measures to guide them in the provision of best safety practices.

Yau Lee is committed to supporting all its subsidiaries to achieve it. By adopting the international OHSAS 18001 System, Yau Lee ensures occupational safety and health through the proof of past excellent safety performance records. It achieved a very low accident rate, which is over 50% lower than the industrial average and wins numerous safety awards. During the year, Yau Lee maintained their record of zero fatalities and the accident rate per 1000 workers achieving 6.58 while the construction industry average is 29.9. The total number of lost days due to work injury was 3,894 days.

Apart from the safety policy, in line to achieve the objective to minimize occupational injuries, IJM recognizes the need to impart education and disseminate essential knowledge on health, safety, and the environment to all employees. Various training and awareness programs were held to promote HSE culture. These include OHSAS 18001: 1999 and IOS 14001:2004 awareness program, Legal awareness on OSHA 1994, FMA 1967 and EQA 1974, First Aid and CRP training, Emergency Response Plan (ERP), Hazard identification, risk assessment and Risk Control (HIRARC), Environmental Aspect and Impact, Internal Audit Training, Chemical Handling and Chemical Register, Accident Investigation, Traffic management and Road safety, best environmental practice, and EQA: Compliance in practice. IJM describe this effort to improve safety and health as their Health, Safety, and Environmental Management System (HSEMS). Meanwhile, Yau Lee does not handle training but adapts it in the daily actions taken.

5.2 Impacts of the Strategies

After the strategies were implemented, IJM found that the improvement of the safety in a construction company cannot be solely focused on enhancing the work system and developing the new equipment. Shaping beliefs and perceptions toward good safety among workers are also equally important. When the attitude is right, the behavior will be also right. As the good safety performance in Yau Lee means it has a continuous business, any trials to improve safety become significant. Besides the development of the safety management policies and systems in the company, the human factor is also vital to ensure a safe working environment and

performance. Apart from Yau Lee, IJM also emphasized the importance of human factors towards safety. This includes workers' beliefs, values, attitudes, and mindsets about safety. At the same time, cases that occurred within the companies highlighted the need to engage with safety for the entire supply chain from clients to subcontractors and suppliers.

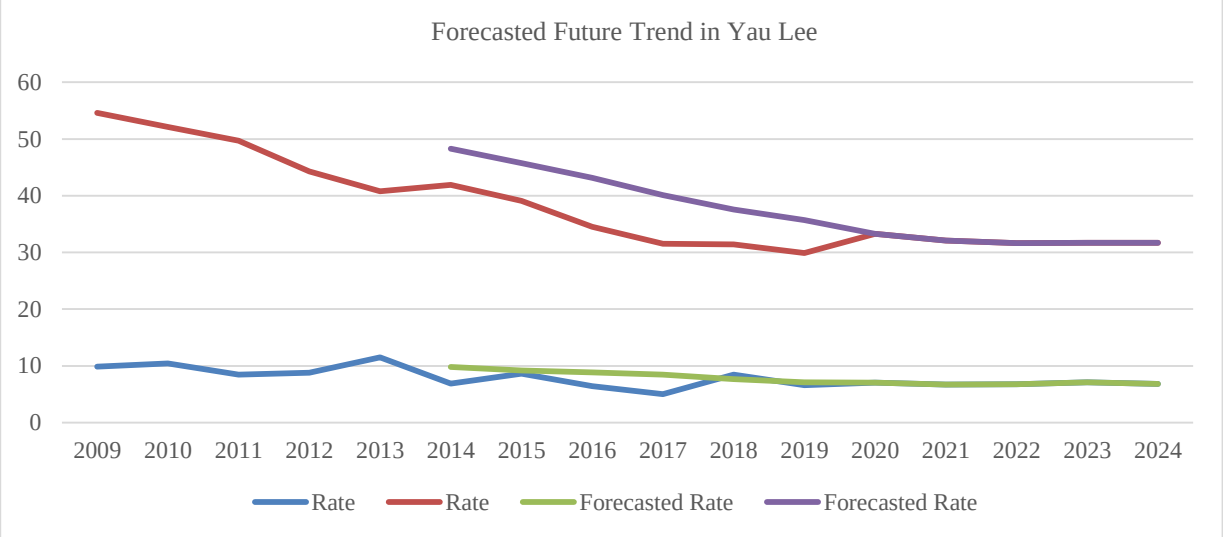

Figure 3: Forecasted Future Accident Rate per 1000 people in Yau Lee from 2020 to 2024 compared to the industry using 5 Years Moving Average
Source: Yau Lee Annual Report

From Figure 3, it is also expected that in the next five years, the accidental rate per 1000 people for Yau Lee after implementing the strategies will remain almost unchanged at around 6.6 people for every 1000 people. The number remains lower than the average forecasted industry average of around 31 people for every 1,000 people. Using the 5-Year Moving Average method, the forecasted rate and the expected rate are not much different for both Yau Lee and the industry. For Yau Lee itself, the difference is quite small and can almost be neglected. The data shows that the strategies being implemented in Yau Lee can reduce accidental deaths and make the city stable in the next few years.

6.0 Conclusion and Recommendations

This section summarizes and conclude the discourse on occupational injuries risk in IJM and Yau Lee it also made recommendations for the industry practitioners and researchers.

6.1 Conclusion

This study brings attention to two major risks frequently encountered in the construction sector: human resource loss and environmental loss. Both of these risks are particularly significant for companies like IJM and Yau Lee, which have identified them as critical threats to their operations. If left unmanaged, these exposures can lead to severe financial losses that may jeopardize the financial stability of these companies, potentially even pushing them towards insolvency. Given the magnitude of these risks, IJM and Yau Lee have taken proactive steps to mitigate their effect by implementing a comprehensive set of strategies that include both physical and non-physical measures. These strategies aim to reduce the likelihood of occupational injuries and minimize the financial repercussions associated with these risks. Table 1 shows a detailed summary of the exact actions engaged in by both establishments to effectively manage the risks related to occupational injuries in their operations.

Table 1: Summary of Strategies being implemented by IJM and Yau Lee to Handle Occupational Injuries.

Physical Strategies	Non-physical Strategies
Set-up committees and practices	Implement safety policy
Develop innovative tools on site	Introduce OSHA system
	Educate the employees on safety

Source: Authors' Own Stated Strategies

The implementation of these strategies has the potential to greatly stabilize, or even reduce, accident rates within both companies, thereby lowering their overall exposure to financial losses. In doing so, they address a key challenge in the construction industry—human resource loss—which can be mitigated more effectively as accident rates decline. This not only safeguards the workforce but also enhances long-term operational stability for the companies involved.

6.2 Recommendation

Construction companies are encouraged to adopt a comprehensive approach, blending both physical and non-physical strategies, to effectively reduce occupational injuries. Physical strategies tend to be most effective during the execution phase of construction, focusing on immediate, hands-on measures to ensure safety on-site. In contrast, non-physical strategies are essential during the planning stage, involving activities like safety training, risk assessments, and procedural safeguards. By combining strong, thoughtful planning with accurate execution, companies can significantly reduce the risk of workplace injuries, fostering a safer environment for workers.

Furthermore, future research should aim to quantify the impact of these strategies on workplace accidents and injuries. Empirical evidence supporting the effectiveness of these approaches would greatly benefit the industry. Quantitative measures could include factors such as the number of safety committees within an organization, the presence and use of physical barriers, and other safety protocols. This kind of research would be especially valuable for companies like IJM and Yau Lee, providing them with actionable data to fine-tune their safety management efforts.

In addition to quantitative analysis, further research is also needed to expand on the findings of this study using qualitative approaches. Methods such as phenomenology and empirical research through case studies could provide richer, more nuanced insights into how these strategies function in different contexts. While the health and safety management practices explored in this study are based on well-established models, it's essential to recognize that they are not exhaustive. Different countries have varying health and safety regulations that might require additional measures or precautions not covered here. Therefore, broadening the scope of research to account for these differences is critical to developing a more holistic understanding of construction safety management globally.

6.3 Practical Implications of the Study

This study highlights the significant potential to enhance safety standards across construction environments in Asia, leading to a reduction in occupational injuries. Achieving this goal requires key stakeholders within the construction industry to focus on fostering a positive workplace culture and mindset, particularly around safety. Workers must adopt positive attitudes, beliefs, and behaviors related to safety performance to create a more secure work environment.

Companies that excel in managing Occupational Safety and Health (OSH) typically share a unified vision of OSH's importance, ensuring that safety is prioritized at every level of the organization. To fully understand and improve safety culture, it is essential to focus on the transformation of attitudes and behaviors. OSH attitudes directly influence OSH behaviors, and this relationship can be explained through a model with four key components: job beliefs, job attitudes, behavioral intentions, and actual safety behaviors. Workers' individual perceptions of their work—whether they consider it inherently dangerous, risky, or safe—play a pivotal role in shaping their overall attitudes toward safety, which in turn affects their behavior on the job. By addressing these elements, companies can better align their workforce with a safety-first culture, ultimately reducing the risk of accidents and injuries.

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