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Safety Management In Construction Industries

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ABSTRACT

Due to the high-risk nature of construction work, having a comprehensive construction safety management plan is essential. Construction safety management is the formal process that details how safety plans are rolled out within the company. Using a construction SMS can help companies reduce accidents, improve insurability, and increase productivity across teams. While safety officers play a significant role in creating and executing a safety system, these plans should also be integrated with other company areas. In this article, we'll take a more detailed look at the benefits of implementing a safety plan, and what construction companies should consider when rolling them out.

Keywords: Safety plan, Management, Implementation and Safety efficiency.

1.INTRODUCTION

The construction industry is widely recognized as a key industry that significantly contributes to the socio-economic advancement of regions or nations. It directly or indirectly contributes to the growth of gross domestic product (GDP), serves as a significant source of employment for a large portion of the workforce, and establishes the fundamental infrastructure for other industries' production activities. Global statistics estimate that the construction output value will surge by over 85%, reaching a staggering by 2030. However, alongside this remarkable growth, the issue of safety within the construction industry has become increasingly severe and demands urgent attention in many countries. Despite advances in safety measures, the construction industry continues to experience alarmingly high mortality rates, persisting as a prominent concern in various regions such as Australia, Europe, and North America. Startling Data unveils a striking disparity: while the construction industry employs a mere 7% of the global labor force, it shoulders the burden of 30–40% of fatal accidents. The construction industry is faced with the challenges of frequent accidents and high mortality rates, and safety management in the construction industry is essential for ensuring the safety of human lives and minimizing property losses. Safety efficiency is the key basis for measuring safety and production. In comparison to developed nations, developing countries must place special emphasis on enhancing building safety efficiency. Construction activities in developing countries focus on building national infrastructure. The frequent occurrence of accidents in the construction industry causes distress to both individuals and their families. In addition, it imposes adverse consequences on construction firms and the industry as a whole, such as decreased productivity and increased economic burdens. Thus, developing countries face an urgent need to enhance the safety efficiency of their construction industry. As an exemplary

Representation of a developing country, China witnessed significant growth in its construction industry in 2021. The industry's aggregate output value reached 29308 billion yuan, indicating an 11.2% year-on-year increase. The completed building area reached 4080.28 million square meters, and employed a workforce of 52.82 million individuals, representing 7.1% of China's total employment (China Statistical Year 2022). However, construction projects exhibit unique characteristics, including lengthy construction periods, complex work procedures, extensive open-air and high-altitude operations, and a high mobility of personnel, resulting in numerous potential safety hazards. Consequently, the industry has long grappled with a high frequency of production safety accidents, leading to a significant loss of life. In 2021 alone, a total of 735 safety incidents occurred within the housing and municipal engineering industry, resulting

in 822 fatalities (including 16 major accidents) (Report on Production Safety Accidents of Housing Construction Projects from 2018 to 2019). These safety incidents were reported across all 31 provinces, autonomous regions, and municipalities in China. Safety accidents and hazards are constraining the development of China's construction industry. Construction safety has become an undeniable issue, and the importance of safety management is increasingly prominent. Safety efficiency evaluation and analysis of its influencing factors are important means to enhance safety management within the construction industry, providing improvement directions and methods for safety management. Numerous scholars have conducted research on safety efficiency, but existing studies have certain limitations. On one hand, the accuracy of evaluation models is insufficient. On the other hand, various factors may have heterogeneous effects on different levels of safety efficiency, and existing research has not thoroughly considered these heterogeneous effects.

Therefore, the purpose of this study is to build a more scientific and accurate evaluation system to measure the safety efficiency of the construction industry, fully consider the impact of heterogeneity, and further explore the factors limiting the safety production of construction, so as to take targeted measures to improve the safety efficiency of the construction industry and promote the sustainable development of the safety of the construction industry. This study mainly divides into two stages. Firstly, we select panel data from 30 provinces in China from 2015 to 2021 in the construction industry and establish a Super-SBM model that includes non-desirable outputs. We then combine it with the Malmquist index model to conduct static and dynamic analysis of safety efficiency. Subsequently, we employ a panel quintile regression model to identify and analyses the factors that influence safety efficiency in the construction industry. Displays the research framework. The rest of the paper is organized as follows: Section 2 presents a literature review. Section 3 outlines the methodology. Section 4 details the selection of indicators and data sources. Section 5 presents the results of safety efficiency evaluation and identification of influencing factors. Discussions are provided in Section 6. Finally, Section 7 concludes with a summary, research insights, limitations, and future prospects

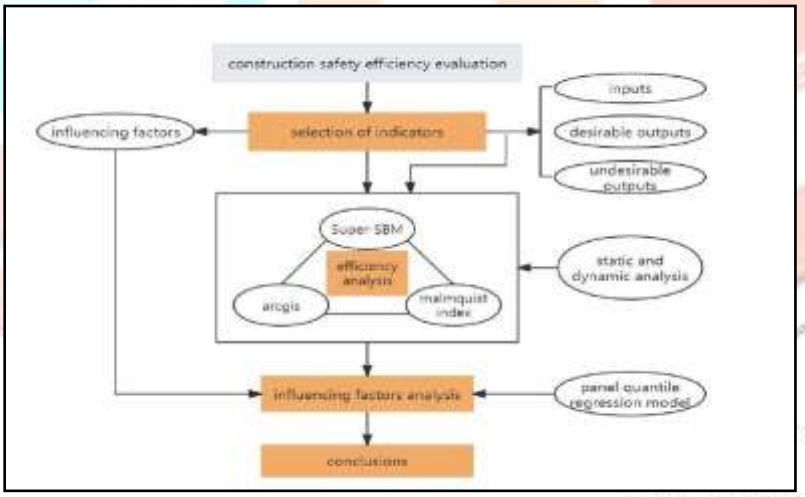

Fig: 1. Main framework of this study.

This paper summarizes the fatal accidents in the construction industry in China over the past ten years. The objectives of this study are: (I) to recognize the status quo and trends of safety in the construction industry in China; (ii) to analyze the features of accidents; (iii) to provide a basis for the government to establish the management regulations for sustainable development by reporting and analyzing the only major accident based on SEA; and (iv) to propose the mitigation measures for project management regarding accidents.

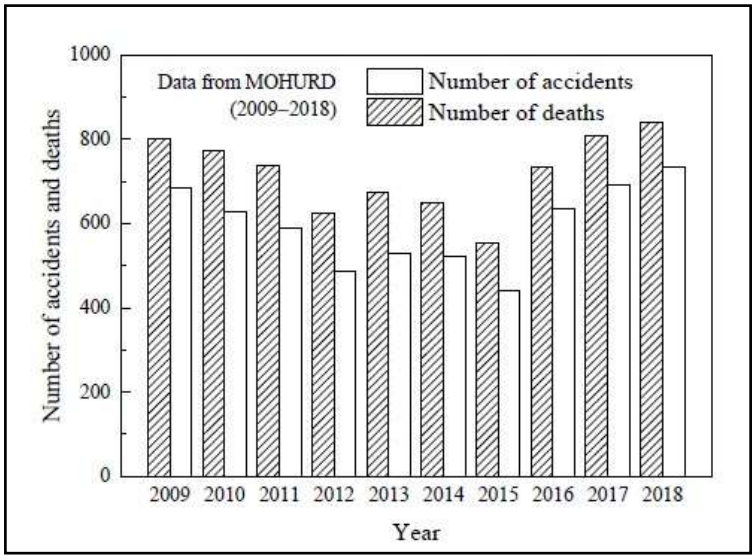

Fig: 2 Fatal accidents related to production safety from 2009 to 2018 in China

2. OBJECTIVE

The construction industry remains one of the most dangerous industries to work in, despite increasing numbers of regulations designed to reduce injuries. However, having a set of governing rules is not the same as applying them. Implementing a safety management system (SMS) is proven to reduce the incidence of accidents and near misses. With today's safety management tools, you can develop a comprehensive and accessible system to mitigate the risks on the construction site.

3. LITERATURE REVIEW

CONSTRUCTION SAFETY MANAGEMENT IN CONSTRUCTION PROJECT – UMESH PATEL, CHINTAN RAICHURA, J. R. PITRODA. CONSTRUCTION ENGINEERING MANAGEMENT, CHARUTAR VIDYA MANDAL UNIVERSITY- The construction industry continues to grow as the demand for infrastructure, homes, and office spaces grows by the day. Since the construction industry is so dynamic, it is vulnerable to a range of health risks. As a result, protection is a top priority in the construction sector to ensure a healthy working environment. Safety experts have determined that risky behaviors cause the majority of workplace injuries, and that controlling these behaviors is one of the keys to effective accident prevention and a low accident rate on construction sites. Safety in construction industry is much more important. This review paper is about to increase safety in the building industry performance. The study's primarily is to define the critical success factors that affect the implementation of construction safety management. This review paper is to recognize and solve major problems in the building sector with various solutions related to work situations that affect project safety performance. Due to lake of knowledge and awareness large number of people's deaths and long-term injuries occurs. Traditional construction safety management has faced challenges as a consequence of the ever-increasing amount of information available, data available. Sensor- based technology is thought to include a new wave of construction safety management techniques because it is an
effective way to collect, identify, and process data. The reason behind this review paper is to recognize and assess Construction project safety control in order to reduce and control construction worker health and safety (H&S). The various safety and control measures of accidents in building projects were outlined in this paper in order to mitigate accidents by using sensor-based technology. and discuss the causes of accidents as well as Drone use for construction safety.

SAFETY MANAGEMENT ON CONSTRUCTION SITE - PRAVEEN.K, KANDASAMY.T PG STUDENT. ASSISTANT PROFESSOR INDUSTRIAL SAFETY ENGINEERING K.S.R. COLLEGE OF ENGINEERING (AUTONOMOUS), TAMILNADU, INDIA - There have been significant reductions in the number and the rate of injury over the last 20 years or more. Nevertheless, construction remains as the one of the high-risk industries. The purpose of this study is to examine safety management in the Indian construction industry, as well as to highlight the importance of construction safety management. The industry has contributed significantly to the economic growth of the country. However, when construction safety management is not implemented systematically, accidents will happen and this can affect the

economic growth of the country. This study will try to put the safety management in construction project as one of the important elements to project Performanice and success. The study will focus on construction project in India. The study will also emphasize on awareness and the importance of safety management in construction project.

CONSTRUCTION SAFETY MANAGEMENT AND ACCIDENT CONTROL MEASURES - DHEERAJ BENNY, D. JAISHREE, DEPARTMENT OF CIVIL ENGINEERING, SRM UNIVERSITY, CHENNAI, INDIA - Construction activities have made a great breakthrough in the last two decades on the back of increase in development activities, and public demand. Still occupational health and safety issues have become major concern to construction organizations. The world society and economy have suffered financial and human losses as a result of poor safety management in the construction industry. The impact is however more in developing countries. The purpose of this study is to explore major safety provisions and also a detailed study has been conducted on safety management procedures in construction sites. Different types of accidents occurring in construction sites and measures taken to control these accidents are also analyzed in this paper. Data's have been collected through various site visits, literature review and from various construction safety standards including BIS and OSHA (Occupational Safety and Health Administration). The paper has been concluded after putting forward a set of recommendations for construction organizations to improve the occupational safety in the construction sites.

ANALYSIS OF PRODUCTION SAFETY IN THE CONSTRUCTION INDUSTRY OF CHINA IN 2018: XIN-HUI ZHOU, SHUI-LONG SHEN, YE-SHUANG XU AND AN-NAN ZHOU - Construction accidents are a significant hazard to the community, an acting sustainable development. This paper summarizes the safety situation of the construction industry in China over the past ten years. Detailed analysis is performed on fatal accidents that occurred in 2018 to reveal the spatiotemporal distribution pattern and characters of construction safety accidents. The construction failures are mainly attributed to management aspects rather than technical aspects. A case involving a major accident during shield tunnel construction in Foshan, Guangdong, in 2018 is investigated in detail. Strategic environmental assessment (SEA) is used to analyze the management issues of the Foshan metro project during planning, geological investigation, design, and implementation of construction works. The SEA result shows that the safety risk was very high with a low total SEA score. Based on the analysis, a guideline for safety construction management for sustainability is proposed.

4. RISK MANAGEMENT FOR SAFETY IN CONSTRUCTION

Risk management procedures for occupational site health and safety can be roughly categorized as in four simple steps that are:

Plan– The safety policies and procedures must be planned as per risk assessment report
Do– Enforcements of policies and procedures.
Check– In order to check for relevance, effectiveness and efficiency of implementation, the safety performance is measured.
Act– Proper remedial measures must be adopted in order to prevent safety and health issues.

A risk management system for safety on construction sites can be considered more of a method rather than a product and this method has to be documented each time it is being implemented anywhere on the construction project so that the safety in charge may keep a check on its effectiveness and can also be used auditing as well as report preparation. Safety in Construction is of paramount importance for the construction industry because accidents and mishaps are caused due to negligence and improper safety practices and workplace conditions. As a safety management system is part of the project management process, enough provisions must be made in this process to feed and document safety processes being followed on site. Construction project management software's can assist in promoting safety systems across different construction sites by updating and analyzing the process being followed.

Fig: 3 Watch: Damaged Buildings in Chernihiv After Russian Shelling and Airstrikes, Rescuers Clear

SAFETY POLICY - A company's safety management plan helps outline the organization's commitment to safety. Specifically, it defines safety roles and responsibilities for all workers and sets clear expectations for everyone in the company regarding safety practices.

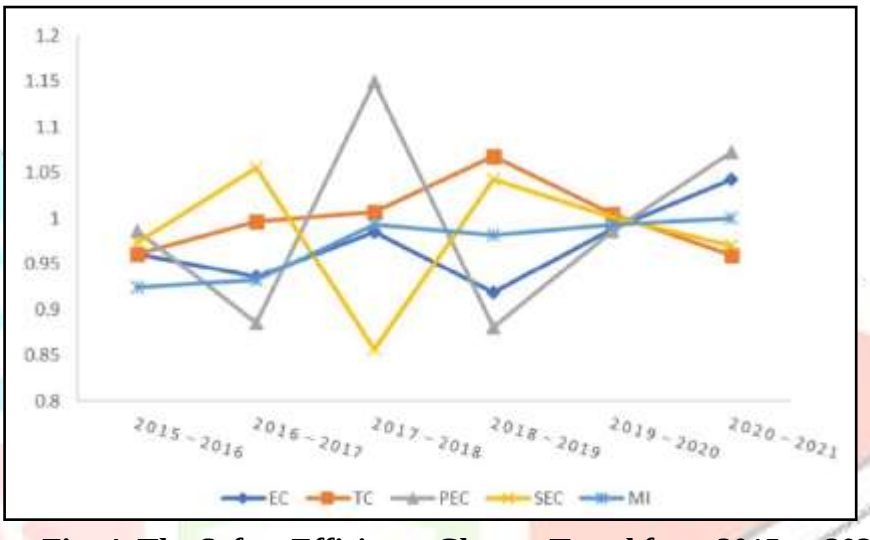

Fig: 4. The Safety Efficiency Change Trend from 2015 to 2021.

HAZARD IDENTIFICATION AND RISK ASSESSMENT - Hazard identification is an essential part of any safety system. Periodic inspections on job sites for potential risks, such as hazardous materials, faulty equipment, and trip and fall risks should be woven into the company's safety policy. Each hazard should be identified and evaluated based on its potential to cause accidents.

SAFETY TRAINING AND EDUCATION - Safety education is key for any construction company, and your training protocols should be outlined in your organization's construction SMS. Trainings should include general safety practices, as well as job-specific safety procedures. Safety stand-downs, for example, are helpful trainings specific to certain topics. If there is an uptick in trips or falls onsite, the construction safety manager may conduct a stand down to review proper procedures and safety protocols with workers. This should include general safety practices, as well as job-specific safety procedures.

EMERGENCY RESPONSE PLAN - safety procedures should include an organization's emergency response plan in case of an emergency, natural disaster, or other situation that could put workers in danger. It's important that onsite personnel are aware of the evacuation processes, contact information for local emergency services, first aid procedures, and who is the safety person to facilitate emergency responses onsite.

INCIDENT INVESTIGATION - It's also critical to include directions for properly reporting accidents or near-misses. These incidents need to be investigated to understand what caused them and prevent similar things from happening in the future. The process for reporting incidents, who receives the report, and how changes are implemented following the investigation should also be depicted and clear for employees.

SAFETY PROCEDURES AND WORK PRACTICES - Another major construction safety management system component is the company's specific workplace plans for jobsite activities. Make note of the process for enforcing safety procedures and what happens if employees don't follow the correct standards.

PERSONAL PROTECTIVE EQUIPMENT (PPE) - Your SMS should have information about the use of PPE on the jobsite. This includes what types of PPE are required for employees in specific scenarios and how workers are trained on proper PPE use. Also, make a note about the company's PPE procurement practices to ensure that your employees always have properly-fitting PPE.

COMMUNICATION - Communication is fundamental to any construction safety management system. It's important to have regular discussions about safety issues, hold safety meetings, use proper safety signage on jobsites, and document safety issues. This keeps safety top of mind for both employees and leadership across the entire organization.

SUCCESS MEASURES - Safety goals should also be considered when creating a company's safety management plan. Safety executives and directors should define the metrics used to measure the safety system's success and hit safety-related goals. This might involve quarterly or annual reports on the company's progress towards safety goals, and what system improvements are made overtime to guarantee positive safety outcomes.

CONTINUAL IMPROVEMENT - Safety plans will evolve and change overtime. The safety system should include regular audits to ensure everyone follows established safety policies and procedures. These reviews should also check for areas that need improvement based on company policy or new industry regulations. This ensures the system's efficiency even as safety goals and plans change.

PRIORITIZING SAFETY HELPS BOOST A COMPANY'S REPUTATION - Every construction company can benefit from an efficient safety plan. A sound construction safety management system keeps everyone in the organization safe and reduces the risk of workplace accidents. And not only does a safety system keep workers safe, it's also a smart business move.

RISK MANAGEMENT - Comprehensive hazard identification, risk assessment and mitigation tools are available, with room for measurement, change and adaptation. It should include planning tools for situations requiring reactive or proactive measures, as well as predictive safety management.

SAFETY ASSURANCE - Benchmarking internal safety monitoring and assessment against goals should account for industry, company or regulatory changes and innovations. As these changes occur, processes should be available to analyze potential risks. The SMS should have tools for actively monitoring safety metrics for quick analysis and continuous improvement.

SAFETY PROMOTION - Training and safety education are vital to each level of the organization. Personal and group responsibility for safety, as well as compliance with the established SMS criteria, include working safely, reporting hazards, open communication and continuous improvement. Based on previous research, the significance of this study lies in introducing the blacklist as a new path for improving construction safety performance in China with an evolutionary game theoretic approach. The blacklist system not only serves as a governance mechanism based on the market but also an effective supplement to government regulation which could be verified by the evolutionary game model that mainly contributes to the following aspects:

It enlarges the current regulatory effectiveness of the government, embodying the multiplicity and long-term effectiveness of the supervision effect.

It forces contractors to accomplish their safety responsibilities and enhances the safety awareness of self-management of all participating units.

All parties in the society participate in co-management and form a good safe production environment.

THE CONCEPTION OF SAFETY INFORMATION SYSTEM - A construction safety information system has been developed for general safety managers and workers. For all the contractors in the construction industry, it would be efficient to build a safety information system to regulate them. Brainstorming is an effective method to create innovative ideas using the wisdom of groups. Besides our research team, the brainstorming participants comprised professionals from different institutions. These institutions could

be divided into three categories: the government, the association, and the contractors. We have organized many seminars and fully discussed the conception of a safety information system, which greatly promoted the research process. In the first seminar, professionals from different institutions first proposed the concept of establishing a safe record system for safety production of construction enterprises, namely a safety information system. In the following seminars, we discussed and confirmed the application scope of the safety information system, as well as the basic principles, the duties of participants, and the standard information collection process. In the final stage, we asked for opinions and suggestions from the construction industry practitioners in three typical cities in China. Our research team investigated the safety assessment method of the local safety supervision department and the establishment process of the information system, in order to draw on the successful experience of the construction of the safe record system and strive to promote the safety information system nationwide.

CONSTRUCTION PARTICIPANTS AND THEIR DUTIES - The main construction participants in the safety information system are three parties: governments, associations, and construction contractors. Governments are more authoritative, and their participation is more necessary than other participants. Therefore, we have defined the role of governments as recorders, aggregators and publishers. Associations assist governments to discipline the industry by improving the industry's credit self-discipline standards and improving the industry's integrity mechanism. As the recorded parties, construction contractors and their employees should comply with laws and regulations. Three participants interact and restrict with one another.

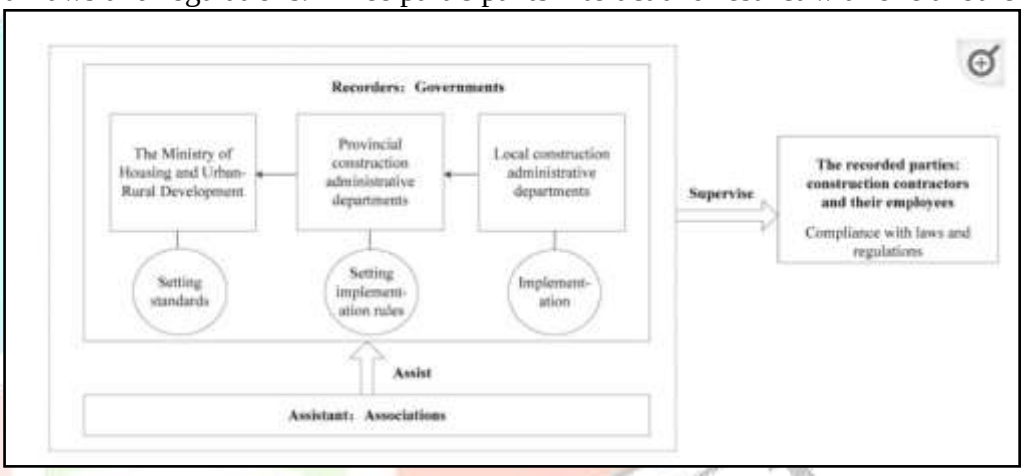

Fig: 5 Relationships among participants and their duties.

The governments are divided into three levels: The Ministry of Housing and Urban- Rural Development, the provincial construction administrative departments and the local construction administrative departments. The local construction administrative departments record the behaviors of construction contractors who break their promise and report to provincial construction administrative departments. Besides setting implementation rules, the provincial construction administrative departments collect information and report to the Ministry of Housing and Urban-Rural Development. The highest level would disclose the information to the public.

MANAGEMENT PROCESS - Complete, timely and reliable safety information is the foundation of the safety information system. The safety information collected by governments from construction contractors is uploaded to the safety information system and updated in real time. According to the information, the safety information system will automatically rate the contractors. Some contractors who have bad performance in safety issues will be put on the blacklist, which means that their business will be affected. The users of the safety information system in the construction industry will be divided into four parts: governments, construction contractors, other social institutions and individuals. Governments could manage contractors in a targeted way, such as strengthening the supervision of blacklisted contractors. The contractors are also users of the safety information system because subcontracting is common in this industry. If the subcontractors have serious incidents during the construction project, contractors also need to take responsibility for it. This is the reason why safety information is significant for contractors. Other social institutions which will have cooperation with contractors have access to the safety information in advance to make the decision about whether to cooperate or not. When looking for a job, the individuals could search for safety information about target contractors so as to enjoy a better working environment.

EVOLUTIONARY GAME MODEL BETWEEN GOVERNMENT AND CONTRACTORS - Evolutionary games were first introduced to describe the evolution of nature lives by biologists. In traditional game theory, the game players are supposed to be rational and they are interdependent with other fully rational players. However, it is almost impossible for players to maintain rationality in every game process. Players in evolutionary games are supposed to learn how to play through experience. These players have bounded rationality and are not the perfect rational persons that are usually assumed to exist in traditional game theory. In addition, evolutionary games still set up the payoff matrix objectively and analyze it through the classical expected utility theory. When the safety information system is put into practice, the government and contractors start to influence each other's decisions. The interaction between them could be regarded as a dynamic game process, because players in an evolutionary game engage in multiple rounds of interaction by adopting different strategies and their interaction state varies from replication games. Therefore, the evolutionary games provide a rational and effective way to introduce the replicator dynamics mechanism where optimal strategies are copied by others and spread in interactive rounds. In this paper, we set up an evolutionary game model between the government and contractors which can be used to analyze the optimal strategies of players.

5 RESULT AND DISCUSSION

5.1 PILOT SURVEY

The pilot survey has been done throughout all of the professional engineers either in the academic, construction or consultancy industry. After obtaining and analyzing the results of the pilot survey, logistical, technical and other issues or problems have been addressed. The questionnaire format was revised, or the type of survey had been altered into a more suitable one. After the revision of the survey being made, the large-scale of the survey is executed.

5.2 QUESTIONNAIRE SURVEY

The questionnaires had been distributed to the project teams of 40 Units 3-Storey Shop-office development consists of the client, consultant, contractor and companies and had received the feedbacks. Since this study is a qualitative study, 30 feedbacks are sufficient enough. The questionnaire consists of three sections, General Information, Importance of Safety Management in Construction Project and Current Practices of Safety Management in Construction Project.

6 CONCLUSIONS

However, this does not show the overall situation in other construction site in the whole country. The company is main contractor for this project, but yet they failed to follow all the rules and regulation of the authority like enforcing the worker to wear PPE at construction site and not to use prohibited machinery like Monkey Hoist. One of the factors that the author can conclude is that the company does not encounter any big safety issues like accident involving death and assets. Thus, they feel comfortable with the condition right now. In addition, the local authority does not emphasize on safety precaution. For example, the usage of the Monkey Hoist is not a serious matter in this state although it has been prohibited by DOSH. Another possible factor lead to this low safety awareness is due to high cost of paying for PPE, Safety and Health Officer Training and salary. It is a big investment to small capital Company like Akas Permai SDN BHD Construction. In terms of methodology, the questionnaire does not provide actual result as compared to direct observation. Beside the respondents wanted to finish answering the questionnaire quickly, they are not showing real responsibility towards their answer. This can be seen in the result of questionnaire whereby the result is not as similar in the site like wearing PPE at the construction site. Thus, direct observation seems to have more reliable source. Besides that, small numbers of respondents have given inaccurate results based on how their answering the questioner caused by time constrain or pressure at work site.

As the recommendation, the management of the company has to realize the performance of the company in safety management as they play a big role in this matter. One of the ways is by restructuring the safety management team. This is to ensure that safety matters are taken cared by a responsible person. Besides that, the government should give the privilege to small construction company in order to set up a systematic construction safety management system. In addition, government should provide free Green Book Training to the workers. Thus, this will enhance the capability of the company to control safety matters in the construction site. Based on the research done, it can be concluded that safety management in construction project needs to be further improved and monitored frequently for its effectiveness. From the survey conducted on the case study, it is believed that the members of the project team had the awareness about safety management in construction project. However, improvements in many aspects need to be considered in order to ensure the effectiveness.

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