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A STUDY OF STATUS OF SAFETY MANAGEMENT AND FACTORS INFLUENCING SAFETY MANAGEMENT IN CONSTRUCTION SITES IN CAMBODIA

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A Thesis Submitted in Partial Fulfillment of the Requirements

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(A STUDY OF STATUS OF SAFETY MANAGEMENT AND FACTORS INFLUENCING SAFETY MANAGEMENT IN CONSTRUCTION SITES IN CAMBODIA), อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ผศ.ดร.นพดล จอกแก้ว, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: รศ.ดร.ธนิต ธงทอง, 169 หน้า.

วัตถุประสงค์ของงานวิจัยนี้เพื่อประเมินสถานะปัจจุบันของการจัดการความปลอดภัย ระบุปัจจัยที่มีผลต่อการจัดการความปลอดภัย และเสนอแนะเพื่อปรับปรุงการจัดการความปลอดภัยในหน่วยงานก่อสร้างสำหรับประเทศกัมพูชา โดยมุ่งเน้นไปที่โครงการก่อสร้างประเภทอาคาร ในงานวิจัยนี้ได้มีการเก็บรวบรวมข้อมูลโดยการสำรวจจากแบบสอบถาม การสัมภาษณ์และการสังเกตสถานที่ก่อสร้าง ทั้งบริษัทรับเหมาก่อสร้างในประเทศ และบริษัทรับเหมาก่อสร้างต่างชาติ

ผลการวิจัยบ่งชี้ว่าสถานะปัจจุบันของการจัดการความปลอดภัยในบริษัทรับเหมาก่อสร้างในประเทศมีความจำเป็นอย่างมากในการปรับปรุงด้านการจัดการความปลอดภัย แต่ในบริษัทรับเหมาก่อสร้างต่างชาติมีการจัดการด้านความปลอดภัยในหน่วยงานก่อสร้างดีกว่า การวัดด้านการจัดการความปลอดภัยในหน่วยงานก่อสร้างทำโดยใช้ปัจจัยทั้งหมด 12 ปัจจัย จากสัดส่วนความคิดเห็นของผู้จัดการโครงการ เช่น การใช้เครื่องป้องกันอันตรายส่วนบุคคล การกำหนดนโยบายด้านความปลอดภัย เป็นต้น จากการวิจัยพบว่า ปัจจัยที่มีผลต่อการจัดการด้านความปลอดภัยในหน่วยงานก่อสร้างมี 9 ปัจจัย เช่น การจัดงบประมาณกับความปลอดภัยนโยบายด้านความปลอดภัย กฎระเบียบความปลอดภัย ความตระหนักของผู้บริหารการก่อสร้าง เป็นต้น สำหรับการปรับปรุงการจัดการความปลอดภัยในหน่วยงานก่อสร้าง ควรมาจากฝ่ายที่เกี่ยวข้อง ได้แก่ ภาครัฐ เจ้าของงาน ผู้รับเหมา วิศวกรความปลอดภัยและคนงานก่อสร้าง

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BUNHAV LIM: A STUDY OF STATUS OF SAFETY MANAGEMENT AND FACTORS INFLUENCING SAFETY MANAGEMENT IN CONSTRUCTION SITES IN CAMBODIA. ADVISOR: ASST. PROF. NOPPADON JOKKAW, Ph.D., CO-ADVISOR: ASSOC. PROF. TANIT TONGTHONG, Ph.D., 169 pp.

The objectives of this research are to evaluate the current status of safety management in construction, to identify factors affecting safety management, and to recommend safety management improvement in Cambodia. This research is focused on building construction projects. The questionnaire survey, staff interview and construction site observation techniques were designed for gathering the necessary data from local and international contractors companies.

The results of research indicate that the current status of safety management in local construction companies is in the low level. It is required a lot of improvement. However, for the international construction companies, they employ better safety management. There are 12 elements of safety management status derived from project managers' opinion such as the use of personal protection equipment, safety policy, and etc. The nine most important factors influencing safety management were identified such as budget for safety management, safety policy, safety regulations, and awareness of project managers. From contractors' viewpoints, the recommendation for improving safety management in construction sites should be arranged by many participants such as government, owners, contractors, safety engineers, and workers.

Department: ……Civil Engineering..... Student's Signature …….
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CHAPTER I
INTRODUCTION

1.1 Introduction

In the majority of industrialized and developing countries, the construction industry is both socially and economically significant. It is one of the most important in contributing to GDP and impacts on the health and safety of working population.

The construction industry gives the home, the building, and the infrastructure where we live, work and relies on. It also contributes a large amount to improving our quality of life. However, many people such as workers and their families and friends, who are involved in the construction industry, experience the unimaginable hurt, pain and suffering with an accident or serious injury. Many people are killed each year in most countries.

Over the world, construction is one of the most dangerous workplace because of its unique nature (Jannadi and Bu-Khamsin, 2002). Construction site safety is a main worry for researchers and practitioners. The construction site safety problem is one aspect of the construction projects phase which have under determined inspections so long. To reduce accidents in working environment, the contractors, owners, and government agencies are obligated to eliminate injuries.

In developing countries, employees and employers should make an effort to increase level of their knowledge of health and safety at work site. Koehn et al., 1995 stressed on the training and implementing of safety program, which should be focused by both developing and developed countries.

Safety record in construction industry has always been poor and it is one of the most hazardous workplaces to work (Carter, and Smith, 2006). Construction failure caused many human tragedies, contribute to a lack of motivation in construction worker, delay construction plan progress, interrupt work activities at site, create high cost, and impacts on productivity and good name of construction firms. The main sources of accidents are associated with the only one of its kind nature of the industry, human behavior, the complexity of work sites conditions and poor safety management which results in wrong methods, equipment and procedure. Avoiding from injuries and illness should be a first concern of all employers.

Safety management in construction should be the first priority of the construction team that includes the owner, architect/engineer, general contractor, construction manager, subcontractors and suppliers. Therefore, the status of safety management and factor affecting construction safety must be explored.

1.2 Problem statement

The uniqueness and complexity of construction industry makes it one of the most dangerous workplaces among industry. Safety management is the major point to make sure that safety procedures are implemented on construction site. Cambodia is one of developing countries in the world. Cambodia has had to begin developing whole sectors from zero point since 1979, including the construction industry which has been the main sector of the nation (NIS, 2003). To develop the whole construction industry all over the country, Cambodia needed to implement many factors for both nowadays and for the future.

In Cambodia, construction site safety is poor. The performances of Cambodian contractor companies on construction safety management are very worry due to the lack of safety regulation, shortage of personal protection equipment, insufficient safety training. From day to day, the construction industry has been booming in the whole country and continues increasing in the future due to the investment of the foreign company such as building, road, bridge, and others infrastructures. More especially, there are a lot of construction buildings booming in Cambodia consisting of housing buildings, commercial buildings, condominium building, and small towns which are called economic zone development. Simultaneously, many problems have significantly appeared on construction projects in Cambodia as the previous study (Menghour, 2008).

From previous research, there are some problems of safety management in developing countries such as poor competency level of construction project manager in Cambodia (Hang, 2010). Hang (2010) revealed that construction safety management in Cambodia is poor of standard. There are many workers injured during the execution of project process because lack of safety training and meeting, low level of knowledge of construction safety, safety inspection and accident investigation. Moreover, in the construction industry in Cambodia, there is little research that mentions about construction safety management and also the status and influence

factor of safety management in construction. Moreover, currently construction safety management in Cambodia is very poor and there are no safety regulations or standards in the Cambodia construction company. Many problems such as accidents, injuries, no safety resources, workers deaths, and no accident reports or investigations, have occurred remarkably in all Cambodian construction projects. All of these problems can be due to the absence of safety standards, and knowledge about application of safety management system in Cambodia. To solve these problems, construction project managers should have studied and been aware of application of safety management system by exploring current status of safety and factors affecting safety management in construction sites.

1.3 Research Objectives

The aims of this research are:

1. To explore current status of safety management in construction sites in Cambodia
2. To identify the important factors influencing safety management in the Cambodian construction sites
3. To recommend the suggestion for improving safety management performance in construction sites in Cambodia from contractors' viewpoint.

1.4 Scope of the Research

The scope of this research is to be conducted in Cambodia (Phnom Penh city and Siem Reap province) involving the status of safety management and important factors affecting construction sites safety management. This research focuses on the project managers in the local and international companies such as contractor firm in building construction projects.

1.5 Research Methodology

For gathering the necessary information from questionnaires, this study consists of the literature reviews, interviews and observations technique. The research will be done step by step as shown below:

1. Review the relevant literature to find criteria to evaluate status of safety management and the factors affecting construction site safety management from various sources. The available sources are text books, journals, international conference papers and also experts. All of the involving literature reviews are presented in Chapter 2.
2. Set up the method and design questionnaire for current status of safety management such as observation by checklist and interview with questionnaires to explore the current status of safety management in the Cambodia construction sites. The questionnaire is clearly designed and is face to face interview with construction project managers in construction firm located in Phnom Penh city and Siem Reap province. The face to face interviews with project managers to identify the factors influencing safety management in Cambodia have also been conducted.
3. Analyze the current status of safety management from interview technique by the number of respondents answering device by the total number of respondents in order to find the percentage of each item of safety management, and from observation technique by number of worker using PPE over total workers to find the percentage of worker using PPE during working task at construction sites. (More clearly in chapter 3).
4. The questionnaires were developed by incorporating the factors affecting construction site safety management gathered from pilot study and relevant literature reviews. The questionnaire is clearly designed and transmitted to those who play a role as construction project managers in contractor companies in Phnom Penh city and Siem Reap province. The number of the samples should be approximately 30 samplings. This questionnaire is formally used to gather the data collection of important factors influencing safety management and the problems caused by those factors.

5. Analyze the data and information from survey questionnaires or interview on the factors influencing site safety management of data collection in order to find the cause of those factors affecting safety management in Cambodia (cause-effect diagram of problems affecting safety management in Cambodian construction sites). Cause and Effect diagram is used to evaluate the data or to present the results.
6. Recommend the suggestion for improving safety management performance in construction sites based on the results and also from contractors' viewpoint.
7. Discussion and conclusion.

1.6 Expected benefits

The future benefits of this study are to realize:

1. The current status of safety management in construction sites in Cambodia
2. The important factors influencing construction sites safety management in Cambodia
3. The contractors' viewpoint for improving the safety management performance in construction sites in Cambodia.

The results of this study are significant because the factors affecting construction site safety management will have been identified. If it was monitored carefully, the accidents decrease in constructions site due to these identifying factors.

Other results of this study could be used as the guideline for construction site safety management in Cambodia. The results of these factors will provide a basis guideline to reduce the accidents at construction sites in Cambodia and also provide a useful instruction for other developing countries which face similar problems in construction sites as construction site safety management in Cambodia.

CHAPTER II
LITERATURE REVIEW

2.1 General

The purpose of this chapter is to explore status of safety management and factors affecting safety management in construction sites from many previous researches. There is a lot of research which have studied about the safety management in construction industry in different regions and countries. They begin with the construction safety management.

2.2 Construction safety management

2.2.1 Safety concepts and definition

"Safety First" is most commonly used at construction sites in all countries throughout the world, but the question is whether safety is really being regarded as first priority as indicated on the notice board.

By Cambridge Advanced Learner's dictionary (2003) safety is used to describe the state of being safe or to describe things that keep you safe. Goetsch (2008) also has one view that safety is involved in injury affecting state, or concerned with hazards to persons that be caused by unexpected severe situations.

Safety is the condition of being safe; the situation of being protected in contradiction of physical, financial, social, emotional, political, occupational, and educational or other consequences of error, failure, injury, accidents, and harm to others events. If the accident prevention can be monitor closely, many benefits are gained from those such as: reduced industrial insurance premium costs, reduced indirect costs of accidents, fewer compliance inspections and penalties, avoidance of adverse publicity from deaths or major accidents, reduced litigation and legal settlements, lower employee payroll deductions for industrial insurance, reduced pain and suffering by injured workers, reduced long term or permanent disability cases, increased potential for retrospective rating refunds, increased acceptance of bids (more jobs), improved morale and loyalty from individual workers, increased productivity from workers, and increased pride in company personnel. The basic

concept of safety is trying to decrease the accidents that occur during the construction process.

In addition, people face many problems related to the unsafe on construction sites and accidents are inevitable in many processes in the industry so safety is more important for human life. Based on this, there is much research that has been conducted and studied about safety, but accidents still occur. So we should focus more and more on safety in order to reduce it as much as possible.

2.2.2 Safety management system in construction

2.2.2.1 Safety management system

Safety Management Systems by Wikipedia is a term used to refer to comprehensive systems designed to manage the safety, health, environmental and general risk aspects of industry. Certain regulatory and enforcement frameworks apply.

By Code of Practice on Safety Management (2002) SM means a system which provides safety management in an industrial undertaking and safety management means the management functions connected with the carrying on of an industrial undertaking that relate to the safety of personnel in the undertaking, including the planning, developing, organizing, and implementing of a safety policy, measuring, auditing or reviewing of the performance of those functions.

In a paper presented by Ming (1994) SM is defined as the policies, goals, organization, management controls and resources which are in place to manage safety, health and environment in all parts of the business. Whittingham and Holloywell (1994) illustrated that an effective SM needs to be a more official form of obtainable management systems for the monitor of both safety and production. Moreover, effective safety management results from the combination of a SM structure and the organization’s safety culture. Burkhardt (1994) states safety management is the application of management systems to identify, understand, and control of process hazards to prevent procedure related injuries and incidents. The British Standard Institute (BS 8800, 1996) defines a management system at any level of complexity is a composite, of personnel, resources, policies and procedures, the

components of which interact in an organized way to ensure a given task is performed, or to achieve or maintain a specified outcome.

The safety advisor is to provide guidance on action to be taken in order to make sure a safe work at site such as action by the company which indicates that safety management has now been integrated into project management. The similar shows that project management can help improve site safety by Suraji et al. (2001). Wilson and Koehn (2000) demonstrated that safety management is a process of controlling safety policy, procedures, and practices relating to project site safety.

- Element of safety management system:

There are 14 key process elements of safety management system by Mak (1996): (1) safety policy; (2) safety organization; (3) safety training; (4) in-house safety rules and regulations; (5) safety committee, (6) program for inspection of hazardous; (7) job hazard analysis; (8) accident/incident investigation; (9) safety promotion; (10) process control program; (11) personal protection equipment; (12) health assurance program; (13) evaluation, selection and control of sub-contractor; and (14) emergency preparedness.

- Benefits of safety management system :

The safety system of the enterprise follows the OSHAS 18002:2000, which are the Occupational Health and Safety Assessment Series advices for implementation of OSHAS 18001. The main features of OSHAS 18001:1999 are (1) OH&S policy; (2) planning; (3) implementation and operation; (4) checking and corrective action; (5) management view; and (6) continual improvement.

The benefits of implementing such a systematic and effective safety health and environment management system could be the following:

- Reducing the number of injuries to personnel and operatives in the workplace through the prevention and control of workplace hazards
- Minimizing the risk of major accidents
- Controlling workplace risks to improve employee morale and enhance productivity
- Minimizing production interruptions and reducing material and equipment damage
- Reducing the cost of insurance as well as the cost of employee absences

- Minimizing legal costs of accident litigation, fines, reducing expenditures on emergency supplies
- Reducing accident investigation time, supervisors' time diverted, clerical efforts, and the loss of expertise and experiences.

2.2.2.2 Occupational health and safety (BS 8800:1996)

Six elements of OHS Management system by BS 8800 are shown as follows:

1. Policy: requirements of safety and health policy reflect the management commitment towards the organizational safety and health.
2. Organizing: the process of allocating the responsibilities and the necessary arrangements to be taken. HSE (1991) describes the four C's of organizing as control, cooperation, communication, and competence.
3. Planning and Implementation: Organizations approve a planned and systematic approach to implementing policy. It consists of the management arrangement such as personnel, resources, measuring performance, contingency plans, organization activities, status, review audit and corrective measures.
4. Measuring performance: refer to the monitoring methods and evaluating the occupational safety and health implementation. It explains the objectives and the kinds of monitoring. For example, there are reactive monitoring and proactive monitoring.
5. Audit: it describes the process of managing and planning the audit. The measurement of a simple parameter or a routine inspection is extremely less comprehensive than occupational safety and health audit. Someone within the group or an outsider can conduct this component. A grouping of these two is often mostly useful.
6. Initial and periodic status review: the primary review status will give for the existing system of information. These will be able choice to be formed on its possibility, acceptability and execution. For the progress that can be measured, it will act as baseline. While the periodic status review will control the result of the system implement and identify the necessary root of action to be taken to improvement any insufficiencies.

2.2.2.3 Occupational Health and Safety Assessment Series (OHSAS 18001: 1996)

To be well-matched with ISO 14001 Environmental standards of management systems and the ISO 9001Quality, OHSAS 18001 has been formed. They do like this in order to smooth the combination of environmental, quality, and occupational health and safety management systems by organization.

OHSAS 18001: 2007 was made by the concentrated effort from amount of the world's leading national bodies of certificates, standards bodies, and professional consultant companies. A major reason to establish this was to attempt to remove misunderstanding in the place of work from the increase the certifiable specifications of Occupational Safety and Health.

The OHSAS requirement provides needs for an occupational health and safety management system, to be able an organization to manage its Occupational Health and Safety risks and its development. It does not talk about detailed performance of Occupational Health and Safety criteria, nor does it provide full specific of a management system design. The OHSAS applications and benefits to an organization are:

- Establish an Occupational Health and Safety management system to reduce or minimize risk to staffs and others interested parties who may be exposed to Occupational Health and Safety risk related with its activities.
- Implement, maintain and continually increase an Occupational Health and Safety management system.
- Assure itself of its conformance with its stated Occupational Health and Safety policy and revealed as conformance to others.
- Look for certification/registration of its Occupational Health and Safety management system by an external organization.
- Make a self-determination and announcement of conformance with this Occupational Health and Safety Assessment Series specification.

Occupational Health and Safety management system contains of six components as follows:

1. General requirements
2. Occupational Health and Safety Policy
3. Planning
4. Implementation and operation
5. Checking and correcting action
6. Management review

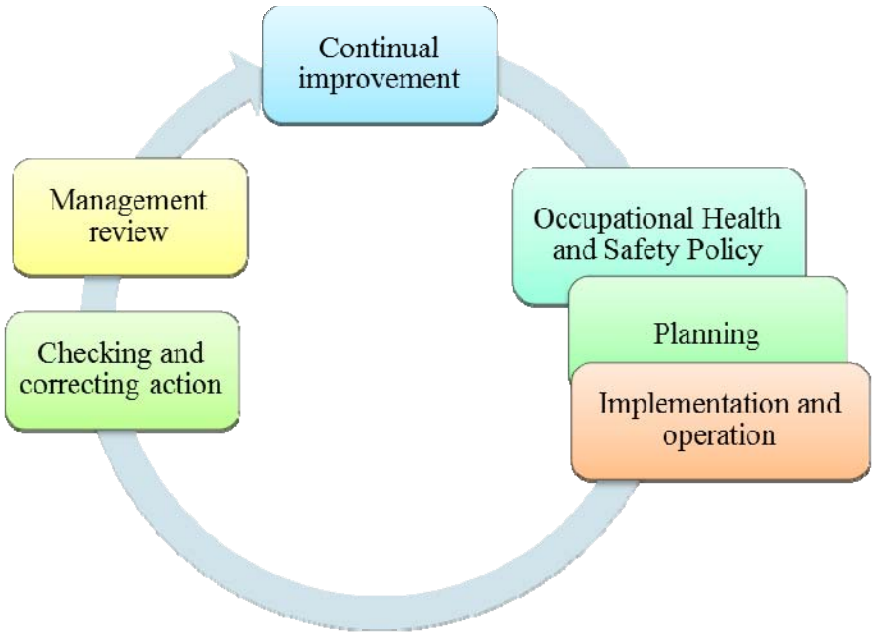

Figure 2.1 Occupational Health and Safety Management system element of OHSAS 18001: 1996

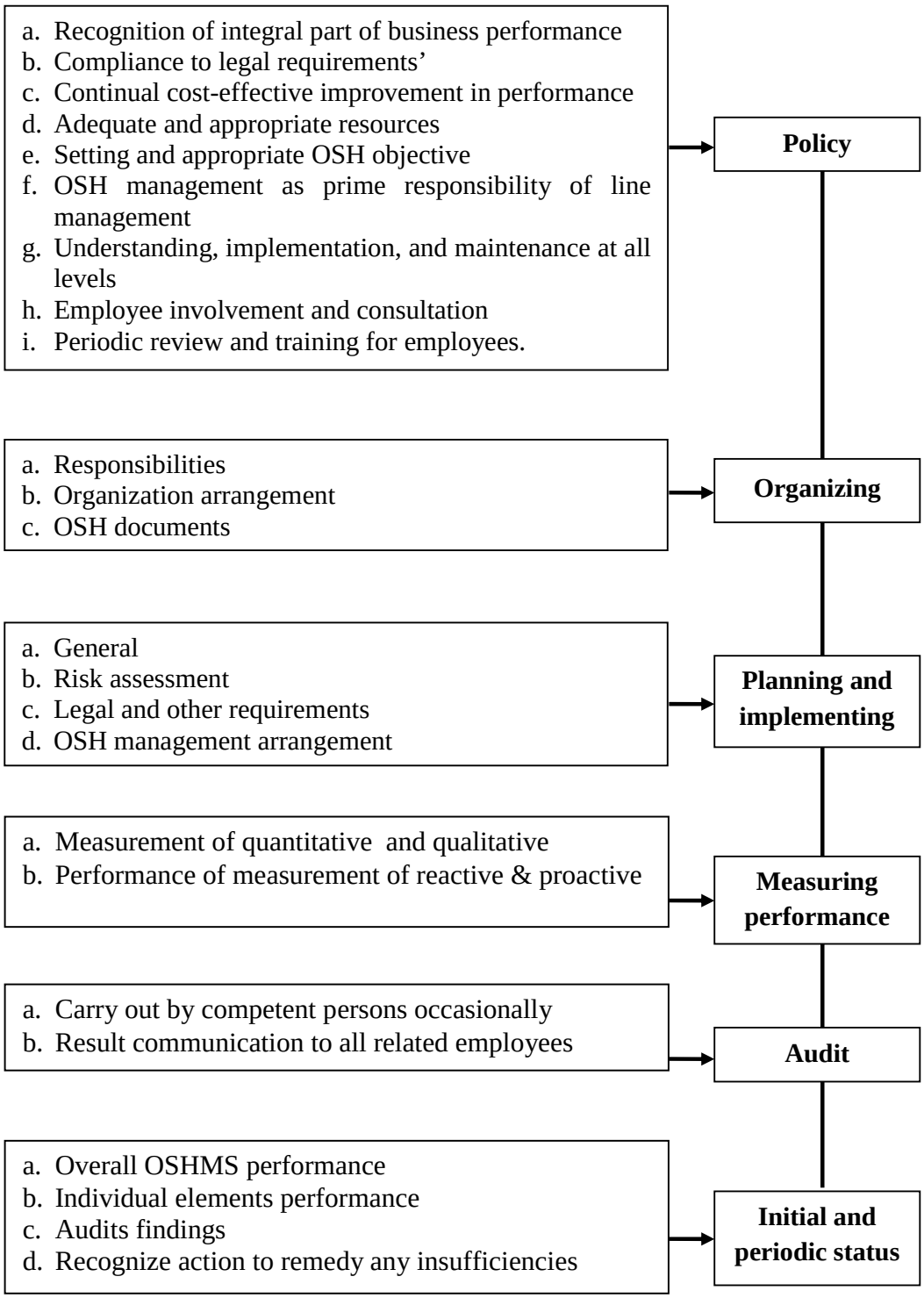

Figure 2.2 Occupational Health and Safety Management system elements of the BS 8800: 1996

2.2.2.4 Occupational Safety and Health 2001 (ILO: International Labour Organization)

1. Introduction and objective: Along with the Instruction on Management System of Occupational Safety and Health the positive influence of giving Management Systems of Occupational Safety and Health at the company level, employers, employees, and government now recognized on the accidents decrease and on production and reduced risk. According to internationally approved principles determined by the ILO's tripartite elements, ILO has developed the OSH-SM of guiding principles. An available the strength, flexibility and suitable basis were provided by three-party approach, for a maintainable safety culture improvement in the association. Therefore, the voluntary guiding principles has been developed by ILO on management systems of Occupational Safety and Health, which indicate ILO values and tools related to the workers' protective of health and safety. The guidelines for level of national must be:

- ✓ Framework for management system of Occupational Safety and Health was used to create a national, firstly agreed and helped by national ruling and law.
- ✓ Offer guidance for the charitable preparations of improvement to make stronger agreement with standards and regulations directing to constant development in performance of Occupational Safety and Health.
- ✓ Improvement both of tailored and national guidelines on management systems of Occupational Safety and Health by providing as guidance to reply suitably to the actual organization needs, based on their activities nature and their size.

The guiding principles of the organizational level are planned to:

- ✓ Make a recommendation to combine the components of Occupational Safety and Health management system in the organization as an policy elements and management preparations
- ✓ Encourage all the origination members namely, employers, managerial staff, workers, owners, and employees' representatives, to apply suitable Occupational Safety and Health management methods and principles to constantly develop performance of Occupational Safety and Health.

2. The national structure of Occupational Safety and Health management system: The Occupational Safety and Health management systems of national policy should form general procedures and principles to:

- ✓ Encourage the integration and execution of management systems of Occupational Safety and Health as all part of an originate management
- ✓ Develop voluntary preparations for the planning, systematic identification, development, and implementation of activities of Occupational Safety and Health at national and organization levels
- ✓ Motivate the involvement of workers and their representatives at level of organization
- ✓ Execute the improvement to avoiding unimportant administration, cost, and bureaucracy
- ✓ Encourage cooperative and back activities for Occupational Safety and Health management systems at the organization level by occupational safety, a group of inspectors of labor, and health services, and direct their actions into a regular framework for Occupational Safety and Health management
- ✓ Assess the usefulness of the national policy and framework at suitable in short period of time
- ✓ Assess and announce the usefulness of Occupational Safety and Health management systems and practice by appropriate resources
- ✓ Make sure that the safety and health minimum needs at the same level, employs to contractors and their labors as to the employees, including employed directly, short-term workers, by the association.

3. The Occupational Safety and Health Management System in the Organization: OSH is the obligation and responsibility of the proprietor, which includes agreement with the Occupational Safety and Health requirements done according to national standard and law. The owner should express powerful control and guarantee to Occupational Safety and Health events in the organization, as well as organizing applicable activities for the creation of an Occupational Safety and Health management system. The policy, planning, organizing, and execution, assessment and action are the important components of improvement system.

2.3 Safety management in previous research

There are many researchers that have researched about the safety management in construction industry such as Jannadi (1996) who pointed out that there are 6 major factors influencing construction industry safety as the following: (1) maintaining safe working conditions, (2) establishing safety training, (3) cultivating good safety habits, (4) effective controlling of subcontractors, (5) maintaining a close supervision over workers, and (6) assignment of responsibility to all level of management and workers.

Hinze and Raboud (1988) have revealed that all successful SM systems must be helped by management commitment, top management and funds are indispensable to reduce accidents rates. Senior management is the connection between the operating level and the top management. Safety awards usually deliver the winners with social recognition as well as financial prizes, which are persuaders to attention of the senior management on safety related problems, otherwise who are worried by many repetitive issues and occurrences of unexpected events; thus give the middle management, the subordinates, and supervisors, to show that their managers are extremely dedicated to cut down the accident rate, on the one hand and offering them additional properties for safety problem. It is normal that the providing of safety award campaigns and safety orientation program to the senior management staff shall lead to reduction of accident rate.

The researcher that has researched explains a study of safety attitudes, carry out, their relationship to safety implementation on construction sites and characteristic of construction companies in Hong Kong (Tam and Fung, 1998). The result showed that the usage of straight employed labor, the donation of safety training, and post-accident investigation are the most operative instrument in decreasing site accident as a reaction, and promoting safety practices by safety award campaigns and incentive patterns.

Sawacha, Naoum, and Fong (1999) investigated the factors affecting safety on construction sites and the seven groups of major factors were considered as (1) historical, (2) economical, (3) psychological, (4) technical, (5) procedural, (6) organizational, and (7) the working environment. Statistical Package for Social

Science was used to analysis the data to search the factors influencing safety. Therefore, the results showed five important problems related with site safety that are: (1) management talk on safety, (2) providing of safety booklets, (3) providing of safety equipment, (4) providing a safe environment, and (5) appointing a trained safety representative on site.

Hinze, et al. (2000) have researched the moving toward a zero injury objective and he found that the five high-impact zero accident techniques such as (1) pre-project/pre-task planning for safety; (2) safety orientation and training; (3) written safety incentive program; (4) alcohol and substance abuse programs and (5) accident/incident investigations played a vital role in safety performance. The result of this study revealed that construction organizations are applying a variation of programs for safety improvement and more significantly, these programs have been related with good safety performance, whether measured in term of recordable lost time injury incident rates, injury incident rate, or experience adjustment rates. Finally, the five-impact techniques have been implemented by many firms and these techniques have been augmented with new approach to promoting construction safety.

Ahmed et al. (2000) have conducted the research in Hong Kong on site safety management. Six main aspects in 14 elements of site safety management have been investigated such (1) safety policy; (2) safety organization; (3) safety training; (4) program for inspecting hazardous condition; (5) personal protection equipment; (6) safety promotion. Occupational health and safety currently was regarded as the important part of site procedures in all construction firms. To show an improvement on construction site safety, a well-defined, comprehensive, and practicable safety plan should be formulated. It should be based on the company's safety policy, carefully tailored to site condition, and reviewed occasionally. Carrying out safety audits is the most effective method for reviewing the site safety plan and improving the company's safety performance.

Table 2.1 14 Main safety management system (Ahmed et al., 2000)

No	Safety management system
1	Safety policy
2	Safety briefing
3	Safety organization
4	Safety committee
5	Safety training and promotion
6	Safety inspection
7	Risk assessment and hazard analysis
8	Accident investigation
9	Hazard control program
10	Emergency procedures
11	Health assurance program
12	Personal protective equipment
13	Evaluation selection and control of subcontractors
14	Safety audit

Tam, Fung, and Chan (2001) have studied the attitude changes in people after the implementation of a new safety management system under the supervision plan in order to evaluate awareness of the new regulation of site personnel, and to evaluate any change of attitude by applying an attitude changed model; reinforcement theory, to forecast the changing attitude and human behavior in the construction industry. The results show that, in Hong Kong, the attitude of construction practitioners are changing to be more positive side of workplace safety when they have received more information to approve that persons really are put in jail for carelessness under the supervision plan.

Jannadi and Bu-Khamsin (2002) intended to find the important level of factors affecting safety performance of contractors' firm based on the 20 main factors in table below:

Table 2.2 Factors influencing safety performance of contractor (Jannadi and Bu-Khamsin, 2002)

Main Influencing factors affecting safety performance of contractor	
1	Site planning and housekeeping
2	Welfare facilities
3	Emergency/disaster planning and preparation
4	Sign, signals and barricades
5	Materials handling, storage and use
6	Welding and cutting
7	Concrete and concrete formworks
8	Crane and lifting equipment
9	Chemical handing
10	Electrical equipment
11	Handing, transportation and disposal of hazardous material and waste
12	Personal protective equipment
13	Fire prevention
14	Transportation
15	Excavation, trenching and shoring
16	Scaffolding and ladders
17	Hand and power tools
18	Mechanical equipment
19	Ionizing radiation
20	Management involvement

The results showed that management involvement, ionization radiation, personal protective equipment, crane & lifting equipment, emergency/disaster planning & preparation, scaffolding & ladders, electrical equipment, prevention, excavation, trenching & shoring, and mechanical equipment are the essential main factors of safety performance influencing the construction contractor.

Tam and al., (2002) tried to evaluate the safety management system and ranking of these measures by considering the various decision criteria. The non-structural fuzzy decision support system is applied to assist the decision making process for these multi-objective problems. Modified non-structural fuzzy decision support

system is presented that is suitable for the evaluation of complexity of construction problems, which allows assessments based on a pair-wise comparison of alternatively using semantic operations, even under the condition that inadequate precise information is available. Seven major elements of safety management system are identified as the following: (1) safety audit, (2) effective safety training, (3) increase competency of supervision, (4) increase management involvement, (5) safety promotion, (6) establishment of safety policy, (7) eradication of hazards.

Tam, Zeng, and Deng, (2004) have identified elements of poor construction safety management in China by studying the safety management status and identify the affecting factors of construction site safety. The results of this research showed that lack of providing of personal protection equipment, regular safety meetings, and safety training are a big worry for contractors on safety management. This research also recommends that the government should play a more vital role in harsher legal enforcement and organizing safety training program.

Table 2.3 The items used for status of safety management measurement in China construction site (Tam et al., 2004)

No	The items for status of safety management
1	Safety manual and procedure
2	Provision of personal protective equipment
3	Safety meeting and training
4	Impact of site accidents
5	Perceived probability of serious accidents in site

Table 2.4 Previous research on safety management (Tam et al., 2004)

Previous research on safety management		
Area	Items	Relative research
People's role	Role of leaders	Hakkinen (1995), Koehn et al. (1995), Levitt and Parker (1976),Tam and Fung(1998) and Wentz (1998)
	Worker's behaviour	Hinze (1981) and Yu (1990)
Organization and management	Training	Gun (1993), Hakkinen (1995), Hale (1984), Krause (1993) and Tam and Fung (1998)
	Safety system	Hale et al. (1997), Hal and Hovden (1998), Hinze (1981), Jaselskis et al (1996) and Tam et al. (2001)
Apparatus and equipment	Equipment	Jaselskis and Suazo (1994), Krause (1993) and Larsson and Field (2002)
Technology	Technology control	Blank et al. (1997), Lingard and Holmes (2001) and Jannadi and Assaf (1998)
Industrial relationship	Market	Hinze and Reboud (1998) and Kartam et al. (2000)
	Safety regulation	Gun (1993) and Seppala (1995)

Table 2.5 Factors affecting construction site safety (Tam et al., 2004)

RII of factors affecting construction site safety		
Ranking	**Factors affecting site safety**	**RII**
1	Poor safety awareness of firm's top leaders	0.93
2	Lack of training	0,90
3	Poor safety awareness of project manager	0.89
4	Reluctance to input resources for safety	0.86
5	Reckless operation	0.86
6	Lack of certified skill labor	0.84
7	Poor equipment	0.82
8	Lack of first aid measures	0.81
9	Lack of rigorous enforcement of safety regulation	0.74

Table 2.5 Factors affecting construction safety (Tam et al., 2004), (cont.)

RII of factors affecting construction site safety		
Ranking	**Factors affecting site safety**	**RII**
10	Lack of organization commitment	0.71
11	Low education level of workers	0.68
12	Poor safety conscientiousness of workers	0.65
13	Lack of personal protective equipment	0.62
14	Ineffective operation of safety regulation	0.59
19	Lack of protection in material transportation	0.53
20	Lack of protection in material storage	0.51
21	Lack of teamwork spirits	0.50
22	Excessive overtime work for labor	0.49
23	Shortage of safety management manual	0.48
24	Lack of innovation technology	0.43
25	Poor information flow	0.40

Teo et al,. 2006 studied developing a model to measure the effectiveness of safety management systems of construction sites. This paper described the development and testing of a model to calculate the construction safety index (CSI) and its accompanying set of tools that can be used to audit the effectiveness of construction firm's safety management system. It is concluded that the CSI can act as an objective measure of different site for management and appraisal purpose. It also revealed the 14 main safety management elements systems under Code of Practice 79.

Table 2.6 14 main safety management elements (Teo et al,. 2006)

No	**Element of safety management system**
1	Safety policy
2	Safe work practices
3	Safety training

Table 2.6 14 main safety management elements (Teo et al, 2006), (cont.)

No	Element of safety management system
4	Group meeting
5	Incident investigation and analysis
6	In house safety rules and regulations
7	Safety promotion
11	Hazard analysis
12	Movement control and use of hazardous substances and chemicals
13	Emergency preparedness
14	Occupational health programs

Choudhry, Fang, and Ahmed, (2008) described an exploratory study of site safety management in construction sites environment system for a leading construction company based in Hong Kong. This study was conducted with the questionnaires to explore the status of safety in the construction sites by investigating the eight aspects of construction safety management such as (1) safety policy and standards, (2) safety organization, (3) safety training, (4) inspecting hazardous conditions, (5) personal protection program, (6) plant and equipment, (7) safety promotion, and (8) management behavior. The results of this survey might have been very useful to many constructions companies where the safety awareness is not high, and have also distributed practical knowledge to construction project managers and construction safety practitioners in order to make more safety in construction sites.

2.4 Conclusions

In short from the relevant literature reviews, there are 12 elements of SM that have been used to evaluate the current status of safety management in construction sites in Cambodia.10 factors from literature reviews are also used to identify factors influencing safety management in Cambodia. More detail of 12 components as seen in chapter 3, Table 3.3, and 10 factors are: poor safety awareness of project manager, safety training, personal protection equipment (PPE), safety organization, safety promotion, safety policy, safety committee, safety program for inspection hazard, site accident/incident investigation, and hazard control program.

CHAPTER III
RESEARCH METHODOLOGY

3.1 General

The methodology of this research was disused in this chapter. In order to make sure of a well prepared research program, the planning and scheduling have been structured thoroughly on methodology, starting with firstly literature reviews, data collection until conclusions. The methods and formulation for data analysis will be shown in this chapter. The overall steps of the research methodology are shown in the research framework (Figure 3.1).

3.2 Literature reviews

A framework of research methodology was well set up through the literature reviews. In this literature review, the purpose is to gather the necessary documents or information, related to status of safety management and factors affecting construction safety management. The literature reviews have been concerned a lot of research that explores construction safety management in many regions or different countries. The sources of the literature reviews can be text books, journals, international conference papers, articles, and safety management manual or safety standards such as OSHA, etc. Moreover, the internet web page, online libraries, electronic databases, and many sources of international or national journals are more important sources of literature reviews.

3.3 Data collection

Observation, interview techniques and questionnaires are set for conducting a survey to obtain feedback and response from relevant respondents. The questions are structured according to purposes of research objectives and the pattern questions are composed of open-end question and closed-end question.

Questionnaire method is tool utilized to gather the useful data information. Based on literature reviews, experts and tool analysis, a questionnaire will be constructed. The questionnaire is clearly designed and transmitted to persons who play a role as contractor firm. Those persons will be asked to describe personal information, the current status of safety management and factors affecting

construction safety management and also suggestion for improvement for safety management performance in construction sites in Cambodia by contractors' viewpoint.

3.3.1 Current status of safety management

This part is the preliminary data collection and it is the most important input in order to know the current status of safety management in construction sites in Cambodia. The data used in this research is based on the site safety management performance. From literature reviews, 12 elements of safety management will be investigated as shown in Table 3.1.

Table 3.1 The elements used to evaluate status of safety management

No	Main items	Evidence
1	Safety policy	Safety policy and standard
		Safety manual and procedure
2	Safety organization	Organization chart for safety performance management
3	Safety training	Safety training plan
		Training program (safety regulation, electrical work, fall protection, fire protection, etc.)
4	Safety program for inspection hazardous	Safety inspection check list
5	Safety committee	Safety committee
6	Personal protection equipment	Head protection equipment (helmet)
		Face protection equipment (full face welding masks, Face shields)
		Eyes protection equipment (glasses, goggles)

Table 3.1 The elements used to evaluate status of safety management (cont.)

No	Main items	Evidence
6	Personal protection equipment	Body protection equipment (wear safety harness, long-sleeved jacket)
		Hand protection equipment (gloves)
		Ear protection equipment(ear plugs a; ear muffs)
		Respiration protection equipment (dust mask, respirator)
		Foot protection equipment (shoes)
7	Site accidents/ incident investigation	Type of accident investigation or report (falling from height, electrocution, hit by falling material, collapse of earthwork, lifting of weights, fire and explosions and others.)
8	Job hazard analysis	Hazard identification checklist
9	Safety promotion	Safety sign and posters
		Bulletin board for safety
10	Health assurance program	Safety health assurance
11	Hazard control program	Program for accident control
12	Emergency preparedness	Emergency siren, alarm system, exit

In this part, questionnaire survey is conducted to help exploring the current status of safety management based on twelve aspects above.

3.3.2 Factors affecting safety management

Before the preliminary data collections, from literature reviews and experts' opinion, the 15 main areas of factors influencing constructions safety management have been selected as seen in Table 3.2.

In this stage, a questionnaire is developed based on 15 factors; from number 1 to number 10 from literature reviews, and from number 11 to number 15 from some interviews in order to explore the important factors affecting safety management in construction sites in Cambodia.

Table 3.2 15 factors for identifying factors affecting safety management in Cambodia

1. Poor safety awareness of project manager	9. Site accident investigation
2. Safety training	10.Hazard control program
3. Personal protection equipment	11.Safety regulation
4. Safety organization	12.Cost or Budget
5. Safety promotion	13.Job hazard analysis
6. Safety policy	14.Emergency preparedness
7. Safety program for inspection hazardous	15.Health assurance program
8. Safety committee	

In addition, questionnaire survey is conducted to help drive the important of factors above that affect SM. Data are collected by using questionnaire survey and interview. These questionnaires were conducted to obtain opinions of project managers related to SM. By Yamane (1973), 30 construction sites were selected to collect data within 30 respondents as project managers of contractors. These project managers are from different contractor firms in Phnom Penh and Siem Reap, Cambodia. For more detail about questionnaire form, it is attached in Appendix A.

3.4 Recommendations for improving construction sites safety management in Cambodia from contractors' viewpoint

After analyzing the results of current status and important factors affecting site safety management in Cambodia, and caused-effect diagram; based on these results, the recommendations from the contractors' viewpoint for improving safety management performance in the Cambodian construction sites were proposed.

3.5 Sample Size

According to Yamane (1973), he provided a simplified formula to calculate sample sizes. This formula was used to calculate the sample sizes for 85% confidence level due to the result of data collection based on opinion of the project managers.

$$n = \frac{N}{1 + Ne^2} \quad (1)$$

Where, n : Sample size (Construction project selected in this research)
N : Population size (The whole of construction projects)
e : The error of sampling (15%)

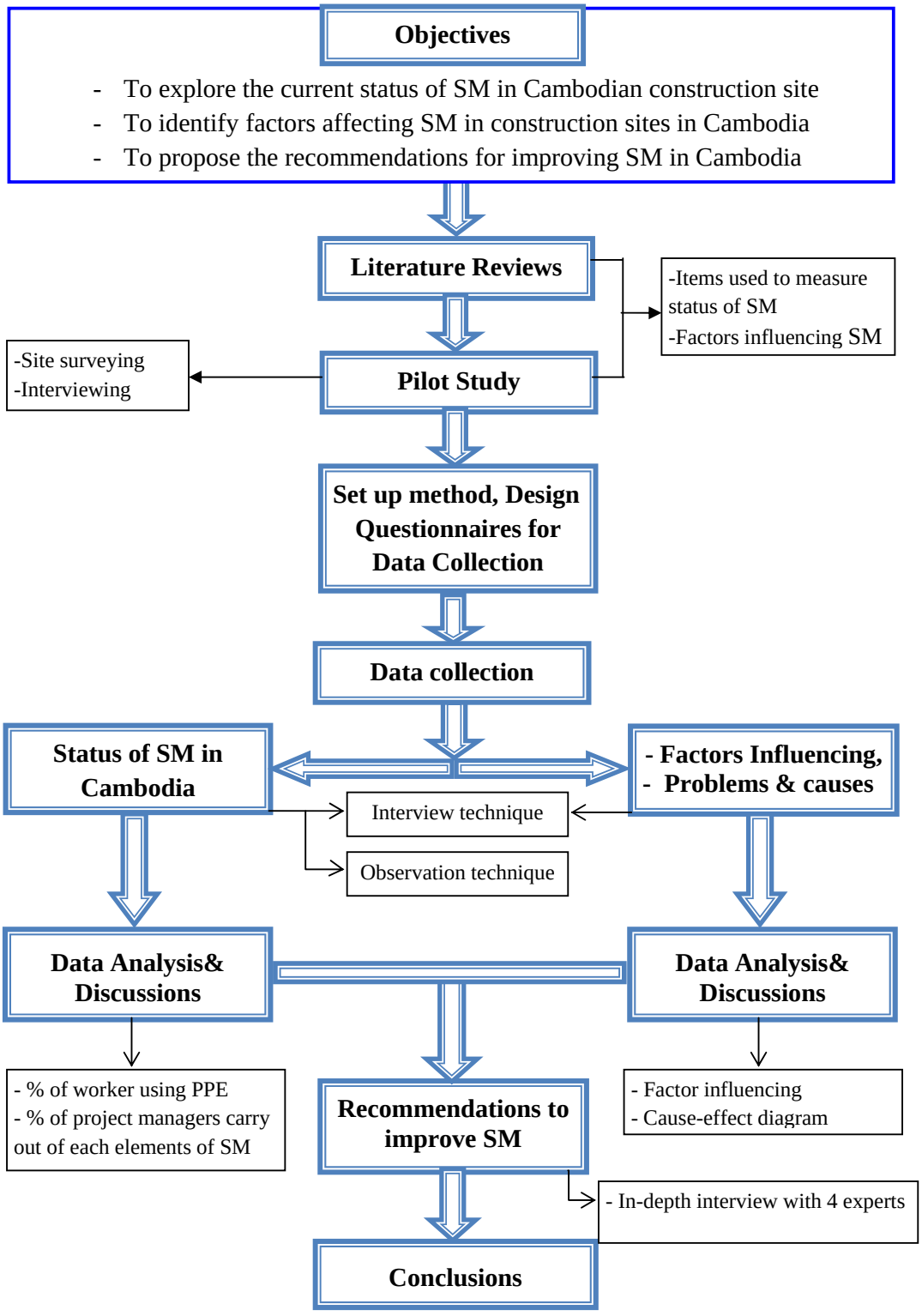

Figure 3.1 A framework of research methodology

3.6 Data analysis

After compilation of responses, every type of crucial data received under different respondents will be appropriately analyzed be an analysis tool. In this case study, there are 4 main types of data as current status of safety management, factors effecting safety management, cause-effect diagram, and in-depth interviews that are taken into account for analysis.

3.6.1 Status of safety management analysis

The techniques that are used to analyze the status of safety management are to interview and observe; to assign the questionnaire to ask by providing the Yes/No answer (Appendix A). The purpose of this data analysis is to explore the percentage of each status of safety management performance in the Cambodian construction sites.

In addition, in order to evaluate the current status of safety management, the results of status will be analyzed by the number of respondents answering device by the total number of respondents, to find the percentage of each item got from observation and interview technique, as see in equation (2).

$$\% \text{ Yes or Use} = \frac{\text{Number of Answer yes or Number worker use PPE} \times 100}{\text{Total Respondents or Total Workers}} \quad (2)$$

- %Yes: %PM carry out element of SM, %Use: % of worker used PPE
- The number of respondent answer by yes, (project managers carry out of each element in company), in case interview technique
- The number of worker use PPE, in case observation technique
- Total Respondents (Total project managers interviewing)
- Total of workers (use PPE), during site observation

Example: if during site observation, there are 12 workers who have used PPE in a construction site and the total workers who work at construction site during site observation are 50, we can calculate percentage of worker using PPE as follows:

$$\% \text{ Use} = \frac{\text{Number of worker use PPE} \times 100}{\text{Total workers}} = \frac{12 \times 100}{50} = 24\%$$

So the amount of worker using PPE=24% in one construction site.

As mentioned in Table 3.3, 12 elements of safety management have been chosen to investigate the current status of the Cambodian safety management in construction sites. Each of 12 components was used in interview and observation technique. In this survey, PPE have used both techniques in contrast to others, which is only for interview techniques and checking evidence.

Table 3.3 The methodology for safety management measurement

No	Items	Observation	Interviewing
1	Safety policy		√
2	Safety organization		√
3	Safety training		√
4	Safety program for inspection hazardous		√
5	Safety committee		√
6	Personal protection equipment	√	√
7	Site accidents/ incident investigation		√
8	Job hazard analysis		√
9	Safety promotion		√
10	Health assurance program		√
11	Hazard control program		√
12	Emergency preparedness		√

3.6.2 Factors affecting safety management analysis

The data analysis of identifying factors influencing safety management have been determined by taking the average percentage number of both local and international respondents companies (see Appendix E). The process of data analysis of each company on which factors have affected, is to first count number of the total answers of project managers on each factor and then divided the total answers on each factor by the total number of respondents (all project managers interviewed).

The upper 50% of the respondents answer on each factor, it means that those factors must be the factors affecting safety management in the Cambodian

construction sites. On the other hand, the factors where amount of answers were lower than 50% were cut out, as seen in equation 3.

$$\text{FA (\% respondent answer>50\%)} = \frac{\text{Number of Respondent answers} \times 100}{\text{Total of Respondents}} \quad (3)$$

FA: factor affecting safety management

Example: if the number of respondents tick or answer on safety policy 25, from the total of respondents (interviewees as project managers) are 30. Based on equation(3), FA can be determined as the follows:

$$\text{FA (\% respondent answer>=50\%)} = \frac{25 \times 100}{30} = 83\%$$

So *safety policy* is FA (factor affecting safety management).

3.6.3 Cause-effect diagram and in-depth interview analysis

In order to improve safety management performance at construction sites in Cambodia, the cause-effect diagrams have been used to find the causes of factors influencing, and the problems caused by those factors. Moreover, the in-depth interviews were also conducted with 4 experts to get the recommendations for improving safety management. The formulation of cause-effect diagram was the same to factors affecting SM as seen in equation (3).

3.6.4 Example of current status of safety management (SSM)

In order to understand process of each analysis, 3 results of research findings on SSM were illustrated. Here are three selected of elements for measurement of current safety management status in the Cambodian construction sites (local contractor) such as personal protective equipment (PPE), safety organization, and safety promotion.

- ✓ Please tick and circle the Yes/No and answer the following question:
- What is the most common PPE provided to workers?

  □ Helmet, □ Face shields/full face welding mask, □ Glasses,□ Goggles,

  □ Long sleeved jacket, □ Safety harness, □ Gloves, □ Ear plugs,

  □ Dust mask, □ Safety shoes, □ Respirators, □ Ear muffs,

Part of observation:

Checklist for observation technique (providing of PPE by local contactors) is shown in Table 3.4.

Table 3.4 Checklist for personal protection equipment

Items	Evidence	Use	Not use
Personal protection equipment	Head protection equipment (helmet)		
	Face protection equipment (face shields, welding mask)		
	Eyes protection equipment (glasses, goggles)		
	Body protection equipment (long-sleeved jacket, wear safety harness with double lanyards for scaffold and riggers and single lanyard)		
	Hand protection equipment (gloves)		
	Ear protection equipment (ear plugs, ear muff)		
	Respiration protection equipment (dust mask, respirator)		
	Foot protection equipment (safety shoes)		

Note: Part observation; put the number of workers using the personal protection equipment under the column Used/Not used into the table above.

Part of interview:

- **Safety organization:**

a. Is there an organization chart showing the name and positions with responsibility lines for safety performance management?

☐ Yes ☐ No

b. Have the individual health and safety responsibilities of all employees been clearly define?

☐ Yes ☐ No

c. Is someone in charge of updating health and safety information, including changes to regulation, new codes of practices, newly identified hazards, and new work practice?

☐ Yes ☐ No

- **Safety promotion:**

a. Are safety bulletin boards provided and located so that all employees can see during the working day?

☐ Yes ☐ No

b. Are accident statistics distributed or displayed?

☐ Yes ☐ No

c. Are safety signs and posters prominently displayed?

☐ Yes ☐ No

d. Does the organization publish a bulletin that includes material related to occupational health and safety?

☐ Yes ☐ No

Table 3.5 Example of results of current status of safety management

Local company : Medium

Items	**Evidence**	**Percentage**	
Site Observation (24 construction sites)		**Used**	**Not used**
Personal protection equipment	Head protection equipment (helmet)	41%	59%
	Face protection equipment (face shields)	21%	79%
	Eyes protection equipment (glasses, goggles)	12%	88%
	Body protection equipment (long-sleeved jacket)	4%	96%
	Hand protection equipment (gloves)	28%	72%
	Ear protection equipment (ear plugs, ear muffs)	5%	95%
	Respiration protection equipment (dust mask, respirator)	12%	88%
	Foot protection equipment (safety shoes)	53%	47%
	Safety Belt (falling from height)	18%	82%

Total of project managers respondent = 24

	Results of status of safety management	**Local company**			
No	**Items**	**Yes**	**No**	**%Yes**	**%No**
2	**Safety organization**			**25%**	**75%**
a		7	17	29%	
b		6	18	25%	
c		5	19	21%	
9	**Safety Promotion**			**49%**	**51%**
a		15	9	63%	
b		1	23	4%	
c		24	0	100%	
d		7	17	29%	

Based on the results of Table 3.5 above, a summary of the providing of personal protective equipment for workers is illustrated in Figure 3.2. It shows that the most PPE provided by contractors are safety gloves, safety helmets, ear plugs, dust mask/respiration, safety shoes, safety glasses, face shields, and long-sleeved jackets; and for all materials of PPE used by workers, we see that only foot protection equipment is 53% used, while others is in contrast.

As mentioned in Table 3.5, safety promotion, 49% of the contractors claimed that they carried out the safety promotion, while 51% did not carry out it. In addition, 75% of the respondents did not have the safety organization and 25% is in contrast.

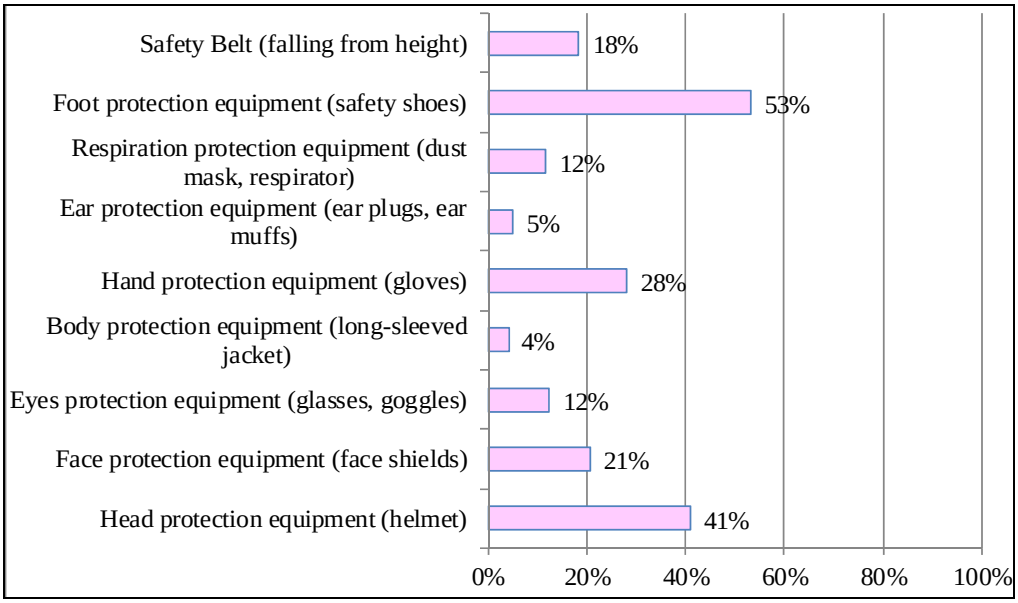

Figure 3.2 Example of personal protection equipment used by workers during site observation

3.7 Conclusions

In summary, this chapter described the whole process of research study as see in research framework of methodology. Data collection is conducted by observation and interview technique. To evaluate current status of safety management in Cambodia and identify factors affecting safety management, 30 construction sites have been observed and 30 project managers have been interviewed. To improve safety management performance, cause-effect diagram has been used by interviewing with 20 project managers and the in-depth interviews with 4 experts were also conducted.

By Yamanee (1973), the sample size has been calculated as illustrated in equation (1). The method of analysis of the current status of safety management, factors influencing, cause-effect diagram, and in-depth interview were respectively from equation (2), and equation (3). In addition to give more understanding, examples of status of safety management have been well provided, and small example of identifying factors and current status of safety management are shown in equation (2), and equation (3).

CHARPTER IV

DATA COLLECTION IN CAMBODIAN CONSTRUCTION

4.1 General

In this chapter, the practice of safety management performance by project managers or safety managers in local and international companies will be described, based on the real current status of safety management and factors influencing safety management in the Cambodian construction sites. Data collection has been conducted directly by observation technique; construction site-observation and interview technique; face to face interview with project managers of contractor companies in Cambodia.

4.2 Cambodia background

Cambodia is one of the world's developing countries and it is located in Southeast Asia, in the southern part of Indochina. Among the 10 countries of ASEAN, Cambodia has an area of 181,035 square kilometers (km^2) with 20% of the land surface used for agriculture. Phnom Penh is the country's capital city (see Figure 4.1). The estimated population is 14,805,358 in 2011. The population is largely Buddhist, with a small Muslim minority (around 2.5%). Riel is Cambodia's currency.

Figure 4.1 Map of Cambodia

Regarding Cambodia's geographic; Cambodia is a country of forested mountains and well-watered plains. The central part of the country forms a gigantic basin for the Tonle Sap, or Great Lake, and the Mekong River, which flows down from Laos to the southern border with Vietnam. International borders are shared with Thailand and the Lao People' s Democratic Republic on the west and the north, and the Social Republic of Viet Nam on the east and the southeast. It has a 443-kilometer coastline along the Gulf of Thailand on the southeast. Apart from the Cardamom Mountains in the South-west and uplands in the North-east, the country is predominantly flat. In the center of the country is the largest lake in South East Asia, the Tonle Sap. The capital, Phnom Penh, is located at the confluence of the Mekong, Tonle Sap and Bassac Rivers. In the north, the Dangrek Mountains, 320 km long and 300-750 m high, mark the Thailand frontier. The short coastline has an important natural harbor, Kompong Som Bay, where the port of Kompong Som (formerly Sihanoukville) is located. The Mekong and the Tonle Sap dominate the life and economy of Cambodia. The Mekong overflows during the rainy season, deposits vast quantities of alluvial soil, and, backs toward the Tonle Sap, causes that lake to increase in size from about 2,590 sq km to almost 24,605 sq km.

Cambodia is divided into twenty-three provinces and one capital city. Phnom Penh is the only capital city and the twenty-three provinces are Banteay Meanchey Province, Battambang Province, Kampong Cham Province, Kampong Chhnang Provinc, Kampong Speu Province, Kampong Thom Province, Kampot Province, Kandal Province, Koh Kong Province, Kep Province, Kratie Province, Mondulkiri Province, Oddar Meanchey Province, Pailin Province, Phnom Penh Municipality, Preah Sihanouk Province, Preah Vihear Province, Pursat Province, Prey Veng Province, Ratanakiri Province, Siem Reap Province, Stung Treng Province, Svay Rieng Province, and Takeo Province. Provinces are further subdivided into districts and municipalities. Districts are divided into communes and quarters then further divided into villages. The municipalities are divided into quarters, which are divided into villages and further divided into groups. The capital is divided into sections, which are divided into quarters, and further divided into villages. The Capital City of Phnom Penh and Siem Reap province are the main areas that have large increase in construction projects and they have been chosen to be my research study, as described

in Figure 4.2 about Cambodian complete construction projects and under construction projects.

Figure 4.2 Cambodian building projects: complete construction & under construction

Cambodia has seen 84% increase in the investments in construction sector during the first seven months of this year, compared with the same period a year ago, according to the statistics from the Ministry of Land Management, Urban Planning and Construction.

The construction sector plays an important role in the economies of country throughout the whole of Cambodia. Many infrastructures projects have increased rapidly in Cambodia. Much of these increases are due to foreigner investors who have come to invest in Cambodia and local owners that have built many types of construction projects which include hotels, schools, flats, apartments, petrol stations, new hydropower plant, garment factories, office building, hospitals, residential areas, villas, condominiums, shopping centers, roads and bridges.

4.2.1 Phnom Penh Background

Phnom Penh is the capital city and the largest city of Cambodia and the population in Phnom Penh was 2,234,566 people in 2011 with the total population density of 3,293.6 inhabitants per square kilometers. Phnom Penh has grown to become the nation's center of economic and industrial activities, as well as the center of security, politics, economics, cultural heritage, and diplomacy of Cambodia. Phnom Penh, along with Siem Reap and Sihanoukville, are significant global and domestic tourist destinations for Cambodia.

Phnom Penh is situated on the banks of the Tonlé Sap, Mekong and Bassac Rivers. These rivers provide potential freshwater and other natural resources to the city. Phnom Penh covers an area of 678.46 square kilometers which some 11,401 hectares in the municipality and 26,106 hectares of roads. The agricultural land in the municipality amounts to 34.685 square kilometers with some 1.476 square kilometers under irrigation. Phnom Penh and the surrounding areas consist of the typical wet plain area for Cambodia and covering rice fields and other agricultural plantations. The city has two distinct seasons. The rainy season runs from May to October and the temperatures can rise up to 40 °C around April and is generally accompanied with high humidity. The dry season lasts from November to April when temperatures can drop to 22 °C.

Phnom Penh is Cambodia's economic center as it accounts for a large portion of the Cambodian economy. Double-digit economic growth rates in recent years have triggered an economic boom in Phnom Penh, with new hotels, restaurants, bars, high rises, and residential buildings springing up around Phnom Penh city.

The main economy is based on commercial interests such as garments, trading, and small and medium enterprises as infrastructures construction sectors. The city plans to expand and construct new infrastructure to accommodate the growing population and economy. High rise buildings will be constructed at the entrance of the city and near the lakes and riverbanks. Furthermore, new roads, canals, and a railway system will be used to connect Camko City and Phnom Penh. Many construction projects have been invested in Cambodia such as Grand Phnom Penh International City, a project jointly developed by Cambodia’s YLP Group and Indonesia’s Ciputra Group, unveiled in 2006.

It has proposed 4,000 residential villas and apartments at a projected cost of US$500 million.

- US$2 billion Camko City project, backed by South Korea-based World City, was the first to introduce the condominium in Cambodia. The project features condominium, a shopping mall, fitness facilities and public gardens on the outskirts of Phnom Penh. It was originally scheduled for completion by early 2010.
- Gold Tower 42 project, developed by South Korean's Yon Woo Co. Ltd, broke ground on July 2007. The project is worth US$240 million and is expected to be completed in 2011, featuring a shopping mall, offices and resident units.
- The Overseas Cambodian Investment Corporation (OCIC) has a project to develop the 100 hectares Diamond Island worth US$800 million, and the company owns the 30-storey high Canada (Canada Bank or Mega Asset Management Co., Ltd).

As shown in Figure 4.3, infrastructure construction projects in Phnom Penh are demonstrated.

Figure 4.3 Infrastructure construction projects in Phnom Penh

With the world economic crisis, the amount of construction project in Phnom Penh has decreased. Some projects under construction such as Camko City have been stopped. Diamond Island has been constructed slowly and also Grand Phnom Penh International City, from the impact of the global economic downturn. The construction sector has been hit hard. Most large scale construction project in the capital have been delayed by the world financial crisis but it will be completed behind schedule.

Early in the year 2011, the Government and Ministry of Land Management, Urban Planning and Construction have made an effort to attract the foreign investors in infrastructure construction project. Meanwhile a lot of construction projects in Phnom Penh such as Grand Phnom Penh International City, De Castle Royal Condominium, International Finance Complex (Phnom Penh, Cambodia), Gold Tower 42, OCIC Tower, and River Palace have been increased or constructed faster in order to finish these projects based on schedule of the construction projects.

4.2.2 Siem Reap background

Siem reap is one of the most famous provinces in Cambodia; with an areas of 10,299 square kilometers, the population was 896309 people in 2008 and the total density population of 87/km^2. It's located in the northwest of the country bordering to the north with Oddor Meanchey, to the east with Preah Vihear and Kampong Thom, to the west with Banteay Meanchey and to the south with the biggest sweet water reserve in Southeast Asia, the huge Tonle Sap Lake. The topography of the province is variable from the Tonle Sap floodplains along the southern border through a belt of lowland paddy fields to lowland/upland mosaic upland forested areas to the North. Siem Reap is classified as a rural province. The World Heritage Site of Angkor Wat is located in this province.

In each year there are many visitors throughout the world who come to Siem Reap province due to the World Heritage Site of Angkor Wat. Siem Reap today, being a popular tourist destination, has a large number of hotels and restaurants. Most smaller establishments are concentrated around the Old Market area, while more expensive hotels are located between Siem Reap-Angkor International Airport and the town along National Road 6. There are a variety of mid-range hotels and restaurants along Sivatha Boulevard, and mid budget to mid-range hotels in the Phsar Leu area.

Businesses centered around tourism have flourished thanks to the tourism boom. There is a wide range of hotels, ranging from several 5-star hotels and chic resorts to hundreds of budget guesthouses. Figure 4.4 shows infrastructure in Siem Reap.

Figure 4.4 Infrastructure in Siem Reap

Similar to Phnom Penh capital city, construction projects in Siem Reap such as some hotels, restaurants, apartments, housing projects, guesthouses, and schools have been constructed very slowly and also stopped constructing the projects because of the impact of world financial crisis.

However, there are still small and large construction projects under construction in Siem Reap. Most importantly, construction project such as few hotels, housing projects, flats and schools were constructed by the small contractors which have not registered the company.

4.3 Construction projects surveying in Cambodia

4.3.1 Data collection in Phnom Penh and Siem Reap

The data collection has been conducted in Phnom Penh and Siem Reap Province. Phnom Penh city is the largest capital city and Siem Reap province is the well-known province in Cambodia. Many kind of construction projects have been booming in both of them such as Hotels, schools, flats, condominium, villas, housing projects, guesthouses, super market and hospitals.

In this research, the capital city of Phnom Penh and Siem Reap province have been selected to study. In Phnom Penh city, there are 25 construction sites that have been surveyed which include housing projects, 5 stars hotel, twin villas, big flats projects, tall condominiums, and commercial building such as Gold Tower 42 project as shown in figure below describing the activity of site observation and interviewing.

As mentioned in Figure 4.4, the high rise building construction project in Phnom Penh are illustrated.

Figure 4.5 Gold Tower 42 & Vattanak project under construction in Phnom Penh

As illustrated in Figure 4.6, 4.7 respectively, these pictures showed the construction projects, which are under construction and the activities of interviewing with project managers of contractors at construction sites.

Figure 4.6 Building projects (under construction) in Phnom Penh

Figure 4.7 Interviewing with project managers of contractors in Phnom Penh

Most of the construction projects in Phnom Penh belong to the private owners as Gold Tower 42 project, developed by South Korea, and Grand Phnom Penh International City, a project jointly developed by Cambodia's YLP Group and Indonesia's Ciputra Group., etc. Some investors used their own capital to build high class condominiums, flats, office buildings and housing projects, and then they sell or rent these assets to those who can have enough money for them. Meanwhile around

the city, some foreign investors or local owners who are businessman have spent their own capital to build some flats, and small villas in order to sell them to buyers (someone who are affordable for are the rich).

In addition, there are 5 construction sites that have been investigated in order to evaluate the current status of safety management in construction sites, identify factors affecting, and cause & effect to improve safety management in the Cambodia construction sites. Those construction sites are 2 hotels, one villa, an office building and a big flat project. Figure 4.8 shows some pictures of building, which are under construction in Siem Reap.

Figure 4.8 Building projects (under construction) in Siem Reap

Figure 4.9, it illustrates activities of interviewing with one project manager of contractor firm in construction sites in Siem Reap.

Figure 4.9 Interviewing with a project manager of a contractor in Siem Reap

4.3.2 Data collection in Cambodia

In all of Cambodia, the infrastructure sector has been booming remarkably including roads, bridges, canals, dams, hotels, and building projects. Phnom Penh capital city and Siem Reap province respectively were selected to study by focusing on the building construction projects in both areas. There are 109 construction projects that have been registered within 20 November 2010 by the Ministry of Management, Urban planning and Construction. Given this number of construction projects based on Yamane (1973), we can calculate the random sample size. The estimated sample size is 32 construction projects selected to investigate and conduct the surveys to get the necessary information for this research. 30 sample sizes have been investigated by observation and also interviewed in both Phnom Penh and Siem Reap. The amount of construction sites observed is 30 and the amount of respondents is totally 30 project managers who were interviewed in detail according to the data set of the questionnaires, which have been clearly defined.

As mentioned in Table 4.1, it will show clearly the number of respondents, estimated sample size, interviewees as project managers, and sites observation.

Table 4.1 Sample size of construction projects and respondents in Cambodia

Cambodia	Total Construction Projects	Sample Size	Number of Respondents & construction site surveys	
			Project managers	Site observation
Phnom Penh City	109	32	30	30
Siem Reap Province				

4.4 Pilot study of safety management in construction sites in Cambodia

A safety management questionnaire was developed to survey 30 construction projects of all the company's construction projects in Cambodia: Phnom Penh city and Siem Reap respectively. The 12 elements have been used to evaluate the current status of safety management which are safety policy, safety organization, safety training, safety program for inspection hazardous, safety committee, personal protection equipment, site accidents/ incident investigation, job hazard analysis, safety promotion, health assurance program, hazard control program, emergency preparedness. After surveying, it can be seen that most of the construction companies in Cambodia have no safety standards or certificate of safety that company have such as ISO 9001 : 2000, ISO 14001 : 1996, and OHSAS 18001 : 1999.

A study of elements of safety management used to measure current status of SM in construction sites in Cambodia are described as the follows:

- **Safety policy**

Generally, the safety policy of construction firms is to provide a safe and health at work place. Policy is the common goals, approach and intentions of an organization together with the criteria and principles on which action and reaction are based. To establish a clear direction for the organization to follow is the successful safety policy. Construction firms have to provide suitable and enough resources to implement the policy with legal requirements as the minimums of safety standards.

In Cambodia, most construction contractor companies set up the policy, done by all staffs: workers, supervisors, senior managers, and top managers need to understand

and implement such as wearing helmet, safety shoes before entrance to work place. They need to adopt and understand what has been stated in the company policy for example they have to use personal protective equipment during working process in the worksite. Project managers, engineers, and others in all organization levels shall have primary responsibility for safety and well-being for their workers. The supervisors have to be responsible for ensuring that safety practices on the part of workers are not overlooked. Employees at all levels have to receive appropriate training when using equipment or machines, work tools protective equipment or devise proper and safe procedures to prevent injuries to themselves ,and are competent to carry out their duties and responsibilities. All contractors firms set up their own safety policy; however, it will be adjusted to comply with the minimum requirement of safety standard by the owners or consultant's policy. In addition, the local owners are not aware of safety in construction sites therefore the contractors will miss or unclearly define this policy during project start and, for example, they can provide only some safety helmets to employees or they do not implement this with legal requirement.

- **Safety organization**

A safety organization provides the structural framework for people in the company to work together in a coordinated manner, based on their knowledge, training and responsibilities, to achieve the safety and health objectives set by the top management. It is a structure to assure carrying out of the commitment to safety and health at work site. The main safety and health responsibilities for each level in the organization chart in the construction are following:

Top manager

- Establish a safety and health policy
- Make sure that the health and safety policy is implemented
- Promote awareness of relevant legislation
- Incorporate safety objectives and targets into contractor firm's Business
- Report to the managing director on all safety issues and coordinate management reviews of contractor firm's Safety Management System.

Senior managers and supervisors

- To provide a safety and healthy working environment

- To provide a system of monitoring compliance with the safety policy
- To understand the safety policy of company and appreciate the responsibility allocated to each position of staff
- To make sure that all levels of staff receive suitable and proper training
- To ensure that pertinent safety and health regulations are complied with.
- To introduce proper reporting, damage and loss, investigation and costing of injury, and promote action to prevent recurrence and start analyses to discover accident trends
- To claim that sound working practices are frequently inspected
- To activate connection with external accident and encourage the sharing of pertinent information throughout the location
- To make sure that injuries, material wastage and tools damage are taken into thought when deciding the overall performance of the site personnel concerned, and set a good personal example on site visits
- To offer an actual, effective safety and health promotion program.
- To ensure that workplace safety rules, processes and methods are developed, maintained and revised.

Workers

- To carry jobsite activities with the minimum of legal requirements
- To share a thinking on ways to improve safety
- To report dangers to supervisors and warn coworkers of accidents
- To report any damage, coincidence at work to supervisors
- To join tool box meeting and other safety activities and to be present in safety training
- To follow safe work practices, processes, instruction and regulations and to implement all duties safely at site

Safety supervisors

Safety supervisors have been selected to assist the safety officer in safety and health at work with company policy or regulation. His duties should be:

- To control workers' compliance with safety standards
- To support the safety advisors, safety officer, or person control of the safety office in carry out his duties

- To instruct senior management as to the performance of safety standard
- To promote the safe implementation of work on site
- To prepare and send the reports to senior management or safety officer at the end of each week on safety performance in the place of work.

Safety advisors or safety managers, and safety officers

- To implement safety policy or safety plan and to assist in the identification of hazards and evaluation of risk at work
- To advise senior management to protect incidents to personnel and damage to equipment, minimum requirements of standards related to safety, health and environmental protection, and further improvement or change code of practice.
- To conduct safety and health inspections to check safety implementation
- To carry out accident investigations, identify the sources of any grave accident or dangerous happening and propose helpful or precautionary measures
- To design and conduct safety training for all levels of employee, and keep records of such training for reference and keep contact with official and professional bodies
- To keep inform with suggested codes of practice and new safety works and mix information applicable to all levels of employee
- To carry out site inspections, liaise with the person in charge of the works and superintendents to see the operation of safety methods, and to observe all legal requirements and contractor company’s regulations
- To prepare a monthly safety report to project safety management such accident reports, safety daily meeting
- To review and update safety plan based on the process of projects
- To be well up-to-date about place of work safety implement
- To prepare and submit the reports regularly to safety offices or managers on safety and health performance at the work in site.

Safety consultant

- Carry out regular inspections and audits of the site and monitor general site-safety performance in respect of compliance with statutory requirements and construction company's Safety Policy
- Attend Site Safety Committee meetings and be pro-active and assist in promoting safety consciousness on site
- Advise of constructors company on changes in legislation and statutory requirements affecting occupational safety and health
- With the assistance of the safety officers, closely monitor the effectiveness of the auditing program and institute a safety-instruction system for subcontractor action, and set a good personal example.

A lot of Cambodian local contractor companies have no safety organization structures (showing the name and function with responsibility lines for safety implement management), and most of them have one site engineering to control all safety issues at work place. They rarely have safety organization structure except when they bid for the project with the foreign owner or the government plan funded by the foreigner such as Japan, Korean investors and so on. In contrast, international contractor firms require the health and safety organogram and on each project, site organization charts must be displayed on the notice boards indicating the responsibility of safety advisor for every section of the project.

Safety training

Safety training plays a vital role in improvement of safety performance on construction sites by instructing new skills and awareness of work safety and without risk to health as well as improving attitude and behavior. It is also to help people acquire the skills, knowledge and attitudes to make them competent in safety and health aspects of their works.

Moreover, a detailed training plan which are: purposes, syllabus, instructor, period and regularity for each training topic should be organized by the project safety officer. That plan, which must be reviewed when there is a change of activity/regulation, and the induction courses should include details of:

- Safety induction: for the first time arrival at construction site, all parties including each level worker have to attend the safety induction course that is

conducted by safety officers. The induction courses contains introduction, company safety policy, general duties, accident reports, safety regulation, procedure of using personal protection equipment, and company safety hand books.

- Safety training for special activities: it must be arranged with the relevant personnel required to work for special activities or under working environment. The appropriate training program is related to site activities, and work process is also provided to workers.
- Tool-box meeting, and safety management training, construction workers registration and training records.

It is necessary to provide the induction courses for the new starters, to introduce the new equipment, new technology to all organization levels such as supervisors, foremen and workers. Therefore, safety training is an operative means of financing in valuable human resource for the effective implementation of the project safety management system.

Most international contractor companies in Cambodia have conducted the safety training at construction sites. For example, training all new employees related to site or work process, operating new equipment, the process of using personal equipment, and also safety officer have a meeting to review or to remind workers every morning before starting the task at site. However, local contractors is usually do not have the safety training at work place and just a small amount of them conduct safety training if they start projects with owner from abroad, such as Japan.

Safety program for inspection hazardous

A program of inspection is to identify hazardous conditions and for the rectification of any such conditions at regular intervals or as appropriate. There is no doubt that daily, weekly, and monthly safety inspections are conducted on site. A contractor should develop, implement and regularly review the inspection program so as to achieve the following goals:

- To identify potential problems that are not anticipated during the design or planning stage
- To identify equipment deficiencies, such as problems caused by normal wear and tear and abuse or misuse of equipment

- To identify improper action of employees and to change in processes which may have bad impact on the safety of workers
- To be responsible for information management to evaluate the safety performance of organization
- To determine management commitment

Site safety inspection program schedule can be discussed as following: safety management committee audit develops a list for members to check monthly audit of each project; safety officer inspection carry formal site inspection to comply with site safety procedure and submit reports to a person in charge of projects; and supervisor inspection shall carry out check list inspection each work day to monitor all site activities under their responsibilities and signed by safety officers.

The person conducting site safety inspection must be competent and have received the appropriate safety training at an external training authority prior to conducting site safety inspections, as competent. It is the responsibility of a competent person to conduct routine safety inspections in his assigned area. He shall promptly report defects or shortcomings to his superior or project safety officer. When he considers a situation to be critical, he shall take immediate action to rectify the unsafe conditions or dangerous situation prior to making a report to the relevant parties.

Safety program for the inspection hazardous conditions is an indispensable portion of vigorous observing program and it is one of the best implements existing to find problems and evaluate their risks before accidents and other injuries occur. The persons operation the inspections should have the proper safety training and capability so that they are capable to find the pertinent hazardous and evaluate the risks association.

After conducting the surveys in the Cambodian construction sites by site observation and interviewing with project managers, international contractor companies occasionally have the safety inspection hazardous program in the work site condition. Most local companies have never used the inspection check list for finding the problems.

- **Safety committee**

Not less than one safety committee of contractors should be created, having the function of finding, recommending, and keeping under assessment processes to

improve the safety and health of the workers in the relevant shareholder such as owner, contractor, and consultant. Contractors should have to arrange own safety group to response each task in work site.

Safety committee's function, a safety committee should conduct the following by:

- Monitoring of the safety policy: determine whether it is sufficient and how well it is being executed
- Evaluation of hazards and preparation to implement safety measures
- Setting up of procedure to deal quickly and successfully with hazardous working conditions, including those coming to light in disputes arising from workers declining to work on the grounds about to happen danger.
- Assistance in the development of safety working procedures and safe systems of work
- Examination of safety audit reports and submission of reports on its observations to the top management with recommendations
- Monitoring of the adequacy and effectiveness of safety training
- Organization of safety promotion events such as safety incentive schemes, safety competitions, exhibitions, and safety recommendation schemes and
- Establishment of links with external sources on the subject of safety

The Site Safety Committee forms a communication channel between project management teams, workers and subcontractors' workers. Group meetings are held for the objective of effectiveness of safety communication, coordination and control of the project safety management system. The safety committee meeting will be discussed all site safety issues, and it shall assist all levels to implement the safety policy.

For proceeding of the meeting, the safety committee's program should be organized ahead and notice of the meeting date published to let all members know at least one week before the date of each meeting. Reports and pertinent documents should be also distributed to all members in advance. The site safety committee includes representatives of staff and workers, the chairman and a secretary. The quorum for the meeting shall be at least 50 per cent of those representing employees. The chairman shall be responsible for implementing the committee's decisions.

Copies of the minutes shall be distributed to all members and attendees within the week after the meeting. Safety committee should bring the decisions and suggestions to the notice of employees and the relevant documents should be displayed to them for reference.

Moreover, safety committee member can come from many participants such as person in charge of the project, site agents, workers' representatives, works superintendents and supervisors, safety supervisors, project safety officer/manager, safety representatives, subcontractors' representatives, safety consultant, client's representative, and other site staff. If it is possible, site safety committee should invite representatives from relevant government. A site safety committee meeting should be held at least once a month.

Especially, nowadays construction projects in Cambodia have no external safety committee to set up to identify, review, and recommend to measure for improving safety and health at work place or to evaluate the work task of safety of contractors at site during project start. Both local and international contractors have a few companies that focus on and implement safety committee by their own policy because most of the project owners rarely give an attention to think about safety. For example, contractors can create an activity on site meeting before starting the work task at workplace by just having a short meeting around 15mn to 30mn in the morning and afternoon between safety officer and group of workers. During this meeting, the safety officer or manager reminds all groups of workers, related to safety work at construction sites about operation of machine, procedure of using PPE, and some areas where accidents are more likely to happen, as seen in Figure 4.10.

Figure 4.10 Safety meeting between safety engineer and workers

Personal protection equipment (PPE)

Personal protective equipment is the most important for employees to protect themselves from unexpected accidents happening during working process. It is not necessary for contractors to become medical professionals, but it is necessary to know enough about the human body to anticipate hazardous conditions that could cause severe or permanent injury. The contractor company must provide the construction personal with an overview of appropriate PPE.

There are a lot of types of PPE such as safety helmet, safety goggles, face shield, welding mask, safety glasses; respirators, dust mask; ear plugs, ear muffs; long sleeved jacket, safety harness; safety gloves; and safety shoes. For a clear picture of each PPE, Figure 4.11 is presented.

Figure 4.11 Pictures of personal protective equipment

- Head protection equipment: be responsible for protection against influence from things fallen and decreases the danger of high energy shock and injury. Safety helmet is necessary for construction area where signpost showing the requirement to wear it is displayed.

- Face and Eyes Protective equipment: eyes and face protectors will be provided when the areas of working can danger face or eyes. Workers shall take care of their eye or face protectors and use them correctly. It includes goggles, face shields, safety glasses, and full face welding masks. The most appropriate eyes and face protection for the work task to be done shall be chosen as follows:
    - Welding work : welding mask must be used correctly
    - Grinding work : goggles and face shield shall be used properly
    - Oxy cutting work : goggles must be used correctly
    - General work : safety glasses should be used appropriately
- Body and falling protection equipment: the workers are required to use a long-sleeved jacket when entering hazardous zone and working at height not more than 2 meters. In contrast, when working at height not less than 2 meters. Safety hardness for scaffolds and riggers must be importantly used with double lanyards and single lanyard for any other line of work. A safety harness shall be provided to each employee working in a location where it is not practicable to install safety nets or to provide standard working platforms or gangways, or where work is being carried out at height.
- Ear protection equipment: The correct type of ear protector shall be provided and used so as to afford suitable protection against excessive noise levels. When workplace is excessive noise of above 85dBA, ear protection has to be used. This can result in a perpetual damage of hearing or deafness. Ear plugs and ear muffs are two types hearing protection that must be used in the noisy zone of noise more than 85dBA. Noise level at least by 20dBA can be reduced by this tool.
- Hand protection equipment: appropriate gloves can protect from damage such as cuts and splinters when handling material and can also protect against dust, wet concrete and solvents, which can cause dermatitis. Safety gloves prevent hand from small injury like cuts and welts. Cotton gloves can be used when execution some general job and when doing rough works like welding and cutting steel bars or plates should be used leather gloves.

- Respiratory protection equipment: dust mask and air purifier or respirators are two types of respiratory protection, must be suitably selected depending on the area of working. From inhaled air, dust mask removes dusts but should not be used it in the existence of toxic dust, in oxygen deficient atmosphere and flammable gases. When using respirators in oxygen poor atmosphere, care is needed to make sure that the shelf life of the cartridge has not been surpassed.
- Foot protection: All those who work on site shall use safety footwear. For work carried out in wet or muddy conditions or below ground level, rubber boots fitted with steel toe-caps and reinforced soles are recommended. Safety shoes provide protection from sliding, injury to the foot from influence of heavy thing and in some cases, protect against electrical shock. Safety sock are also required to be used in order to avoid flashes from arriving into shoes.

In Cambodia, international construction firms have provided enough PPE to employees and also require workers used PPE at workplace. Moreover, the companies have the safety officer to ensure the procedures of appropriate usage of PPE as well as training and instruction in construction sites. The project safety officer shall identify the appropriate type of personal protective equipment for each task or activity. Contractor firms have special training in the correct use of such special personal protective equipment provided to relevant workers. In contrast, nearly all the local contractor enterprises give insufficient PPE to workers even if they have said that they have the requirement of using PPE at work in site. For example, the local contractors can provide only safety shoes or safety helmet to worker and if workers need other equipment, they have to purchase it by themselves. The reasons that local firms do not supply enough PPE to workers are because of the cost of safety package during bidding. The package of safety cost is absent during bidding and also the owner does not considers safety in construction sites.

Figure 4.12 presents using of PPE by workers. These pictures were captured during site observation. Most local contractor worker have no PPE such as safety shoes, helmet, safety hardness, safety gloves and so on or do not use during construction process. More detail is illustrated in Figure 4.12.

Figure 4.12 Site observation shows improper use PPE by workers (local contractors)

Figure 4.13 presents about using of PPE by workers in international company. These pictures have been captured during site observation. Most local contractor, workers have PPE such as safety shoes, helmet, safety hardness, safety gloves and so on or better use them during construction process. More detail is illustrated in Figure 4.13.

Figure 4.13 Site observation of worker using PPE (international contractors)

Site accident/ incident investigation

Investigation of accidents or incidents is to find out the cause of any accidents or incidents and to develop prompt arrangement to prevent recurrence. The investigation of accidents forms part of a reactive monitoring system which is trigged after an event and includes identifying and reporting:

- Injuries and cases of ill health
- Other losses such as damage to property
- Incidents including those with the potential to cause injuries, ill health, or losses
- Hazards, and weaknesses or omissions in performance standards

Each above provides opportunities for relevant contractors to check safety performance, learn from mistakes, and improve the safety management system and risk control.

The investigation consist of 4 ingredients such as collecting evidence about what has happened, assembling and considering the evidence, comparing the findings with the appropriate legal, company standards, drawing conclusion on the causes and recommending measures to prevent recurrence, and implementing the recommendations and tracking progress.

During the investigation process, the supervisor and foreman shall carry out a preliminary investigation report for an accident in their area of responsibility and submit that report to the project safety officer for information. Afterwards, the project safety officer and relevant supervisory staff shall gather all information related to the accident/dangerous occurrence, e.g. photographs, injury or damage data and use that information to conduct necessary interviews and tests in order to collect further information and evidence for analyzing the possible cause of the accident/dangerous occurrence and to establish appropriate control measures to prevent recurrence of that accident/dangerous occurrence or the occurrence of a similar accident/dangerous occurrence.

All reportable coincidences and hazardous happenings should be investigated. Information on all accidents, incidents and hazardous occurrences shall be hold back to the project safety officer for examination, reporting and copy purposes. That

information shall be included in the monthly safety report prepared by the project safety officer.

Accident statistics shall be calculated monthly and the information displayed on the accident statistics board. Those statistics shall be reviewed by the Site Safety Committee to monitor the project's progress in achieving the targets. The accident statistics will be used to analyze accident developments and to improve corrective action to avoid the recurrence of similar accidents.

$$\text{Incident Rate} = \frac{\text{Number of reportable accidents x 1,000 x 12}}{\text{Average number of persons employed}}$$

$$\text{Severity Rat} = \frac{\text{Total days of sick leave x 1,000,000}}{\text{Manhours}}$$

In order to avoid the recurrence of similar accidents on site, accident summary sheets shall be used as training material for workers at tool-box meetings.

In Cambodia, both international and local companies have rarely conducted injury or accident investigation in the construction sites. However they have the accident reports if accidents have been occurred during the construction process.

- **Job hazard analysis**

Job hazard analysis is to evaluate the job associated dangers or potential hazards and development of safety measures. This element refers to the conduct of job related risk assessment and risk control. It consists of 5 steps namely:

- Identification of hazards
- Determination of risks
- Development of safety procedures and risk control measures
- Implementation and maintenance of safety procedures and risk control measures
- Review of safety procedures and risk control measures.

All 5 steps above are to be responsible for resources where by job hazards or potential hazards are recognized, assessed, and managed in a way that reduces them or decrease them to acceptable level.

This will provide the following benefits:

- Setting up of a scheduled work procedure and regular work training by specifying individual job steps
- Providing of a detailed situation for potential hazards and pertinent safety necessities for all relevant personnel involved in the detailed task
- Production of a checklist for checking conformance to safe work practices
- Protest of compliance with legal requirements in provided that a work safe system.

The construction manager or his delegate shall be responsible for developing a job-hazard analysis. The person in charge of the project is required to give full support by assisting him to complete those job-hazard analyses. That support shall include assigning engineering and supervisory staff to discuss each specified task with the project safety officer so as to allow him to understand the process of the task and to provide him with method statements, related information and drawings to enable him to compile the job-hazard analyses.

Particularly, Cambodian contractors both local and international right now seem not to care about this element of job safety analysis. Most of those contractors might be insufficiently aware of safety management task as job safety analysis.

Safety promotion

The purpose of safety promotion is improvement and preservation of safety and health consciousness in a workplace; between all staffs of the organization's commitment to safety and health, and individual person's responsibility to support that commitment. Cambodian Contractors can promote of safety by safety poster or sign, safety bulletin board, safety newsletter, in meeting /seminar, and individual or campaigns.

- Safety newsletter: a safety newsletter in English and Cambodian shall be published quarterly and distributed to site personnel.
- Safety bulletin board: Safety bulletin boards shall be erected near the site entrance and other appropriate locations to display safety news and information from internal and external sources.

- Safety sign or posters: Safety posters relevant to the activities on site shall be displayed at prominent locations and updated/replaced as work activities require. Normally they are placed around construction sites or other locations that employees can see easily.
- Promotion of safety to individual: the manager can help safety straight to all attendants during the typical course of work. Through the day to day contacts, they can get the safety communication across and make labors receive safety as a way of life.
- Promotion safety through campaign: Safety operations usually involve the mobilization of people at different levels for a cause and can emphasis awareness on safety issues and spread the safety message from corner to corner the entire workforce.

Normally international contractors have the safety award and incentive scheme to employees who have conducted well on safety practice complying with company safety policy. The awards can be T-shirt or cash given to the winner by safety manager or officer. The name of employees who win and their photograph are displayed on the site safety notice board. In order to motivate the workers, safety officer have to know how to implement the safety promotion. Local contractor is rarely to does as described above related to international contractors.

As mentioned in Figure 4.14, it has shown the picture of safety promotion as safety sign, safety notice board, and poster.

Figure 4.14 Pictures of safety promotion (site observation)

- **Health assurance program**

It is a program to protect workers from occupational health hazards. Therefore it consists of:

- Identification of hazards
- Determination of risk
- Development of safety procedures and risk control measures
- Implementation and maintenance of safety procedures and risk control measures
- Review of safety procedures and risk control measures

The purpose of this is to provide guidelines for setting and implementing Occupational Health Programs for hearing conservation, respiratory protection,

industrial hygiene and medical surveillance. Site safety committee responsibilities is to set, implement and review specific Occupational Health Program based on health hazards and responsibilities of safety officer is to facilitate and coordinate the implementation of the Occupational Health Program.

- Hearing conservation (noise monitoring and control): Hearing Conservation Program shall be established and implemented for employees exposed to excessive noise level of 85db(A) measured at 8hours equivalent per workday. Noise on construction sites usually emanates from machinery used for demolition, drilling, excavation, piling, compressors and concrete mixers, etc. Operations such as hammering, riveting and the use of cartridge-operated fixing tools may also be the source of excessive noise. To minimize risk of damage of hearing of workers, a competent person shall be appointed to carry out a noise assessment for each noisy operation. Program shall be; testing of noise exposure level for affected employees; regular monitoring of noise level; choosing the correct usage of hearing protectors; displaying signs e.g. “Hearing Protection Area” in appropriate areas.
- Respiratory protection (Dust Monitoring and Control): Respiratory Protection Program shall be established and implemented for employees exposed to significant levels of airborne contaminants. To reduce this, contractors have; to monitor regularly for air contaminants; select a suitable respirator and educate worker on health hazards; ensure that workers wear such respirators through regular supervision and inspection; display signs e.g. “Respiratory Protection Area” in appropriate areas.
- Medical Surveillance Program shall be established to arrest signs of occupational diseases in employees who are exposed to excessive noise or others such substances: arsenic, asbestos, benzene, cadmium, lead, manganese, organophosphates, perchloroethylene, silica, tar, pitch, bitumen, creosote, trichloroethylene and vinyl chloride.

Both local and international contractors rarely conduct all steps of the health assurance program in their construction sites. They simply remind the workers about accidents that have happened in the area of working or just post some sign to warn all employees, related to injury.

- **Hazard control program**

Hazard control program (accident control and hazard elimination) is a program for accident control and elimination of hazards before exposing workers to any adverse work environment. It refers to a process control program aimed at identifying safety and health risk and properly planning the work process to control those risks. It is also considered as the process hazard analysis alike to the risk assessment method. Moreover, Process analysis should be directed toward analyzing the possible reasons and concerns of the happening of accident, particularly those likely to result in damages, explosions, fires, and releases of toxic or flammable substances.

The contractor companies should ensure that all workers fully understand the safety and health hazards of the process; they work for the protection of both themselves and their fellow workers. Project management should set up a program to keep workers from hazards related with the works. The program intends to be organized based on an assessment of accident-control and hazard-elimination measures.

In Cambodia, most local and international firms have never conducted the accident control and hazard elimination. They just remind workers through safety officer about accidents which occurred while working in some jobs.

- **Emergency preparedness**

Emergency preparedness is to develop, communicate and implement plans suggesting the effective management of extra situation. It is essential because when an emergency does happen rapid and precise reaction is vigorous to decrease injuries, diseases, property damage, environmental harm and public worry. Management should identify the types of emergencies the organization needs to plan and prepare for.

Contractors should have an extra planning committee to recognize all possible emergencies, appraise their effects and impact, priorities and analysis list of possible emergency situations. List of emergencies can be electric shock, flammable gas, fire, explosion, hazardous chemical spills, personal injuries and illness, critical damage to facilities/ equipment.

Emergency committee has to know or find the way how to prevent with all list of possible emergency situation. Normally, they need to post a notice of emergency exit or a sign to warn all workers to know where to escape when bad situation occurs.

Generally, the emergency plan should consist of: an alarm system; the processes for reporting and announcing emergencies, and when they are over, revealing a return to normal; an emergency organization; special group for first assistance, rescue, firefighting; training of team participants; an removal rout map and a safe meeting point; a list of authorities to contact in case of emergency.

In addition, both contractor companies, local and international respectively, should have an emergency exit or emergency zone to protect in case of occurring emergency situations. They should have prepared alarm system, and posted some list of contact of police, an ambulance and fire service around areas of construction sites.

4.5 Conclusions

In short, this chapter has explained the practice of safety management performance in Cambodia by both local and international contractors currently. A brief description of Siem Reap, Phnom Penh, and Cambodia were provided with some pictures of infrastructures. In addition most of contractors in Cambodia have no safety standard or certificate.

To be more clear on the 12 components of SM namely safety policy, safety organization, safety training, safety program for inspection hazardous, safety committee, personal protection equipment, site accidents/ incident investigation, job hazard analysis, safety promotion, health assurance program, hazard control program, and emergency preparedness, these 12 elements have used to evaluate current status of SM. The detail of concept and definition of each element have been well explained in this chapter.

In Cambodia, carrying out 12 components of SM by both local and international contractors are explained in the last paragraph of each element in this chapter.

CHAPTER V
ANALYSIS, RESULTS, AND DISCUSSIONS

5.1 General

In this research, all results, discussions and recommendations will be shown in this chapter. Both interview and observation techniques were selected to collect data for gathering the necessary information from the Cambodian construction sites. There are 3 types of data analysis which were illustrated: the current status of safety management, identifying factors influencing, and cause-effect diagram respectively. In addition, the recommendations of contractors' viewpoint for improving safety management were known based on the results of this research.

5.2 Results of current status of safety management in Cambodia

In this study, the results were analyzed according to the data gathering which was collected from observation of 30 construction sites and 30 interviewees as project manager of contractors both medium local companies and large international companies (24 local project managers, 6 international project managers). The results are divided in two parts respectively, current status of workers using PPE by observation technique and current status of 12 components of safety management by interview technique.

5.2.1 Current status of worker using personal protection equipment by site observation

The proper use of personal protection equipment is one of twelve elements of safety management system that have been used to evaluate the current status of safety management and it was divided into two types of construction site observation. One is observed in local construction contractor companies and other one is international companies.

The proper use of PPE by worker in local company

The full results of workers having properly used personal protective equipment at workplace is shown in Figures 5.1.

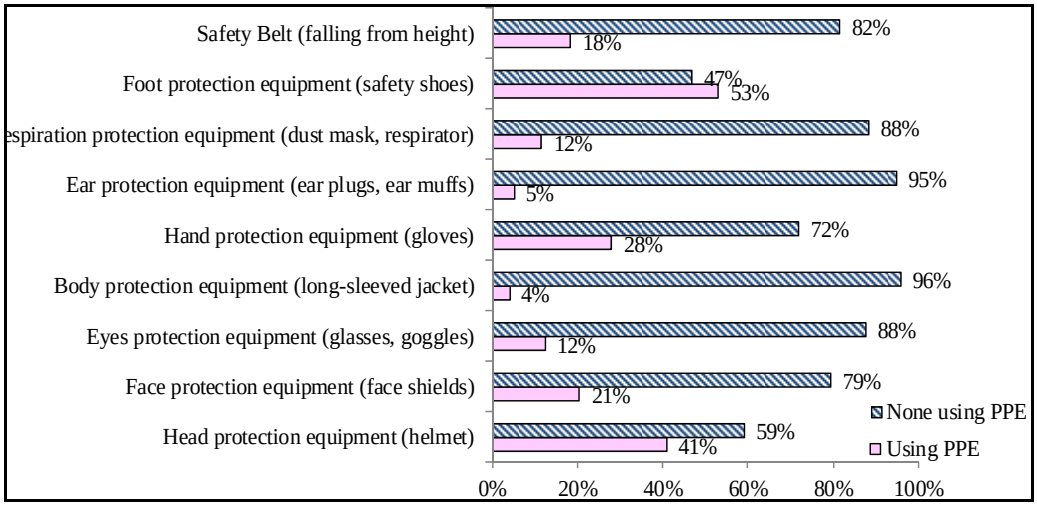

Figure 5.1 Results of site observation in local contractors with 24 construction sites

As mentioned in Figure 5.1, the results of data analysis of workers using PPE indicated that most local contractor companies have provided common PPE to workers, such as helmets, face shield, glasses or goggles, long-sleeved jacket, gloves, dust mask, safety shoes, and safety belts. The results of site observation on local companies showed that most workers used not all PPE during working process at sites. Moreover from 24 construction sites, many workers of local contractors used only better foot protection equipment as safety shoes, 53% of employees used PPE and then 41% used PPE head protection as helmets and so on as presented in Figure 5.1. More detail of raw data and analysis has been put in Appendix C.

The proper use of PPE by workers in large international companies

As illustrated in Figures 5.2, the results of data analysis of workers using PPE indicated that most of international contractor companies have provided most common PPE to workers, such as helmets, face shield, glasses or goggles, long-sleeved jacket, gloves, dust mask, safety shoes, and safety belts.

The proper used of PPE by workers of international contractors is better than local contractors as demonstrated in Figure 5.2, especially body protection, ear plugs, and dust masks, wearing PPE lower 50%, while other PPE was used over 50%. So the proper used by workers of local contractors is worse than international contractors. The full results of workers who properly used personal protective equipment at construction sites, is described in Figure 5.2. (More detail seen in Appendix C).

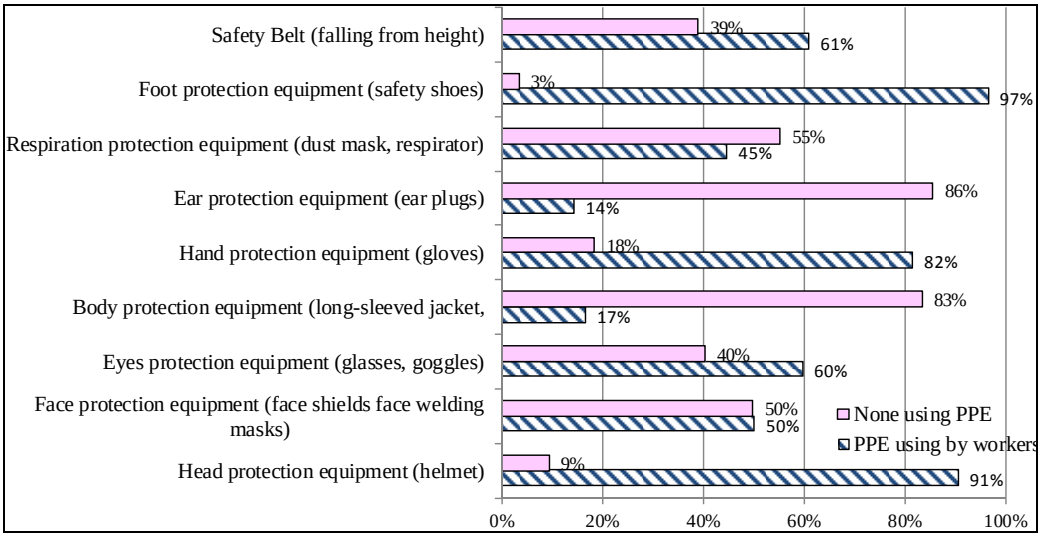

Figure 5.2 Results of site observation in international contractors, 6 construction sites

5.2.2 Current status of safety management by interview technique

In Cambodia, 12 components of safety management system have been used to evaluate the current status of safety management in construction sites. Within 24 project managers of medium local contractors and 6 project managers of large international contractors were interviewed in order to explore the current status of SM. The results of these interviews are presented in Table 5.1, Figure5.3, Table 5.2, and Figure 5.4.

The results of current status of SM were presented in two parts as local contractor and international contractors.

Status of SM of local contractor companies

In order to evaluate the current status of safety management, the full questionnaires have been used as seen in Appendix A. More details of result are shown in Appendix D, (Table D1). Project managers have been interviewed by answering with Yes/No questions. *Yes/No* means that project managers of contractors have carried out or not carried out each element of safety management in their companies and show evidence. The results of current status are shown in percentage, are demonstrated in Table 5.1, and Figure 5.3.

Table 5.1 Results of current status of SM, interviewing with 24 project managers

Items to evaluate status of safety management	%Yes	%No
Safety Policy	44%	56%
Safety organization	25%	75%
Safety training	33%	67%
Safety program for inspection hazardous	11%	89%
Safety committee	23%	77%
Personal Protective Equipment (PPE)	61%	39%
Site accident investigation	46%	54%
Job hazard analysis	8%	92%
Safety Promotion	49%	51%
Health assurance program	13%	88%
Hazard control program	8%	92%
Emergency preparedness	46%	54%

Remark: %Yes: percentage of project manager carrying out each element of SM, %No is in contrast.

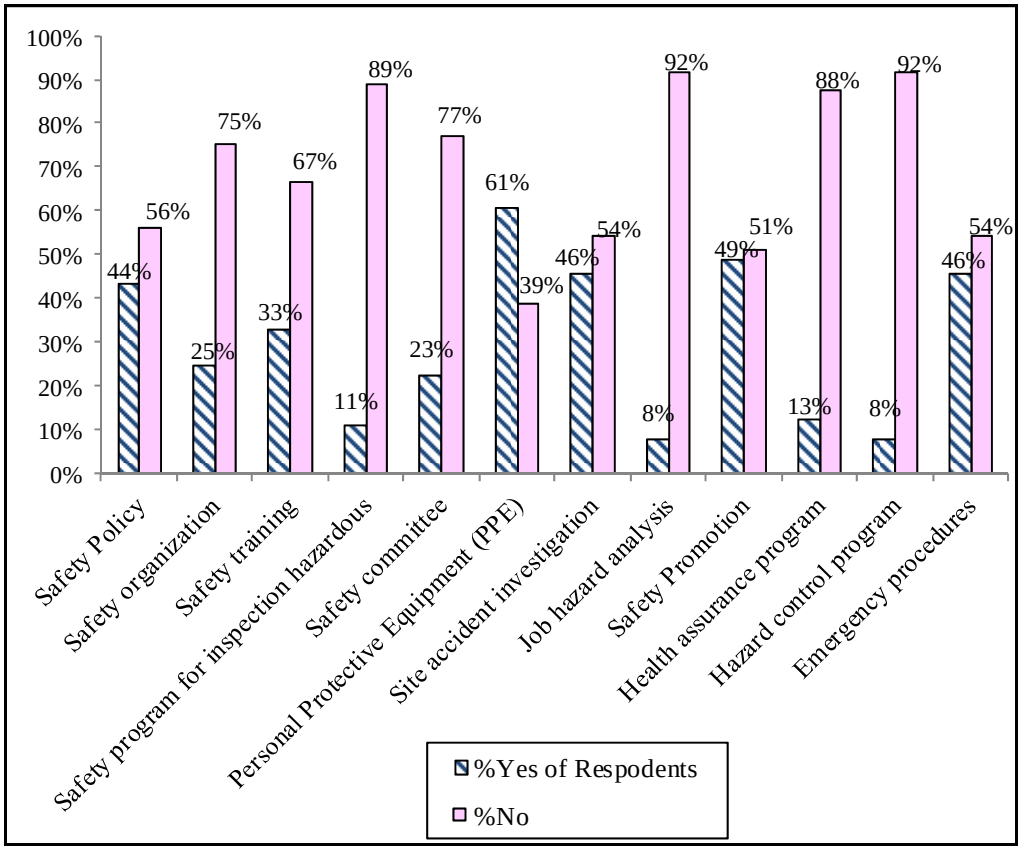

Figure 5.3 Results of current status of safety management, local contractors

As seen in Table 5.1 and Figure 5.3 above, the research findings showed that personal protection equipment is one of elements used to explore current status of safety management, and has been used and good implementation by workers in workplace. The percentage of PPE 61% of the implementation of project managers, while others 11 elements is lower than 50 % of the respondents had been claimed.

More detail of each element will be explained as following paragraph:

Safety policy: From results above, 44% of the respondents claimed that the companies have the safety policy as own companies. The local contractor companies now regard the implementation of safety management system as a necessary part of site procedures. This is with the company's safety and health requirement of policy in questionnaire 1.a. The companies have not committed organizations' policy to comply with all relevant health and safety legislations (1.b). (1.c) the company's policies require having the safety procedures and manuals at construction sites by implementing following local contractors' policy. The local companies have to make sure that policy is the subjects provided safety training to the new employees. The interviewees confirmed that 48% of the safety engineers in local contractors had not made them aware of the safety policy during their training and orientations. (See Appendix H, evidence of company safety policy).

Safety organization**:** On each project, it is necessary to display site organization charts on the notice boards indicating responsible safety advisors for every section of the projects. 25% of project managers have claimed that they conduct the implementation of safety organization in their local firms. For each project, local contractors' safety organization chart should have in the site safety plan as (2.a), 29% of local project managers said that organization charts have been used in companies. As question 2.b was 25% of project managers' respondents, the individual health and safety responsibilities should be allocated to workers orientation training courses. 25% of project managers of local companies are keen to get update of health and safety information, manual of practice and works procedures.

Safety training**:** 33% of the respondents claimed that safety training have been offered by safety engineer to the workers at site, while 67% is in contrast. Interviewees show that 29% of the local companies have established a safety health and training plan which workers are provided to train (3.a). 38% project managers

have provided all the employees the basic or site specific safety training (3 times per week) before starting work at site as in question 3.b. (see Appendix H, evidence of safety training).

***Safety program for inspection hazardous*:** 81% of interviewees have no conducting of safety inspection hazardous. As mentioned in question 4.a, 13% of respondents said yes. So the companies have not made sufficient arrangement to monitor the effectiveness of safety inspection. The local contractors should ask to guide to carry out the strict monthly audits to review the usefulness and attention to detail of the sites safety inspection. The safety officers should conduct weekly inspection of all areas, record the results, and take corrective action to be sure site safety as in 4.b. 13% of project managers said yes that safety officers should carry out safety inspection at regular time. As mentioned in 4.c, 92% of respondents said no, in the appropriate arrangement to gather and evaluate the results of safety inspections. It means that the project managers do not pay much attention to the analysis of safety inspection.

***Safety committee*:** 23% of respondents have set up the safety committees. As 5.a, 92% of interviewees said that their companies are not well enough set up to identify, to recommend and to review measures to develop the safety and health at workplace. But they have a small meeting, or committee in construction sites as 38% local project managers said (5.b). This meeting is just to remind all employees to pay attention on operation or process of each site work. (See Appendix H, evidence of small meeting in construction site).

***Personal protection equipment*:** 100% of the respondents said that all local contractor firms ask all employees to use PPE during work at site (6.a). 50% of local contractors said that they have a method to observe the PPE carried on site by workers as 6.b, and they do like this in order to avoid damages arising from lack of PPE, so safety engineers have to check and control using PPE. As shown in 6.c, 67% of interviewees claimed that they do not have any procedures to check the appropriate use of PPE by workers at construction sites. (See Appendix H, evidence of PPE).

***Site accident investigation*:** 33% of project managers have said that they have conducted the incident injuries investigation in construction sites (7.a). Moreover,

58% of respondents claimed that they have the accident reports for accident occurring at sites. (See Appendix H, evidence of accident reports).

Job hazard analysis**:** only 8% of the respondents have conducted the job hazard analysis in construction sites, while 92% is in contrast.

Safety promotion**:** as 9.a, 63% of project managers said yes. The company is following good practice by displaying safety material on safety bulletin boards so that the employees can read and understand them during working day. The project managers should display the site accidents statistic on safety bulletin board or distribute directly information to workers but only 4 % of project managers have displayed this information to employees (9.b). 100% of interviewees said yes, so it is the good practice that local companies display the safety signs and posters near work areas to increase preventive measures (9.c). The contractor companies should organize best safety sites rivalry, best safe worker competition together with publishing results of assessment surveys of staff on safety in the twice-yearly bulletin, but only 29% have done this (9.d). (See Appendix H, evidence of safety sign, poster and notice board).

Health assurance and hazard control program**:** as in question 10.a, 87% of local contractors have not conducted the health assurance program at construction sites in order to protect worker from many types of incidents happening by chance. Moreover, only 8% of interviewees said that their companies have conducted hazard control program while 92% don't have this kind of program (11.a).

Emergency preparedness**:** generally, each construction site needs to prepare for several types of emergencies before the project starts. They do this in order to avoid a lot of unexpected accidents, for improving safety and evacuate the employees from incidents. As 12.a, 17% of interviewees as project managers have the emergency exit at jobsite while working such as siren or alarm system. Moreover, 75% of respondents of local contractor firms have published and posted list of emergency contact as police station number, hospital telephone or sign as emergency exit, and sign for telling the meeting place for evacuation of employees at the construction sites. (See Appendix H, evidence of emergency exit, contact list).

Status of safety management of international contractor companies

In order to evaluate the current status of safety management, the full questionnaires have been used as seen in Appendix A. More detail of results are shown in Appendix D, (Table D2). Project managers were interviewed by answer with Yes/No questions. *Yes/No* means that project managers of contractors have carried out or not carried out each element of safety management in their companies.

As shown in Table 5.2, and Figure 5.4, these data findings indicate about the current status of international contractor companies on safety management. Only 3 elements of safety management used to evaluate current status is 0%, while others are more than 50%. So it means that the current status of safety management of international contractors is better performance than local contractor companies. As see in Appendix D. The results of current status are shown in percentage, as demonstrated in Table 5.2, and Figure 5.4.

Table 5.2 Results of current status of safety management, international contractors

Interview with 6 project managers, large international contractors companies		
Items to evaluate status of safety management	**%Yes**	**%No**
Safety Policy	88%	13%
Safety organization	78%	22%
Safety training	67%	33%
Safety program for inspection hazardous	50%	50%
Safety committee	67%	33%
Personal Protective Equipment (PPE)	100%	0%
Site accident investigation	75%	25%
Job hazard analysis	0%	100%
Safety Promotion	63%	38%
Health assurance program	0%	100%
Hazard control program	0%	100%
Emergency preparedness	75%	25%

Remark: %Yes: percentage of project manager carrying out each element of SM, %No is in contrast.

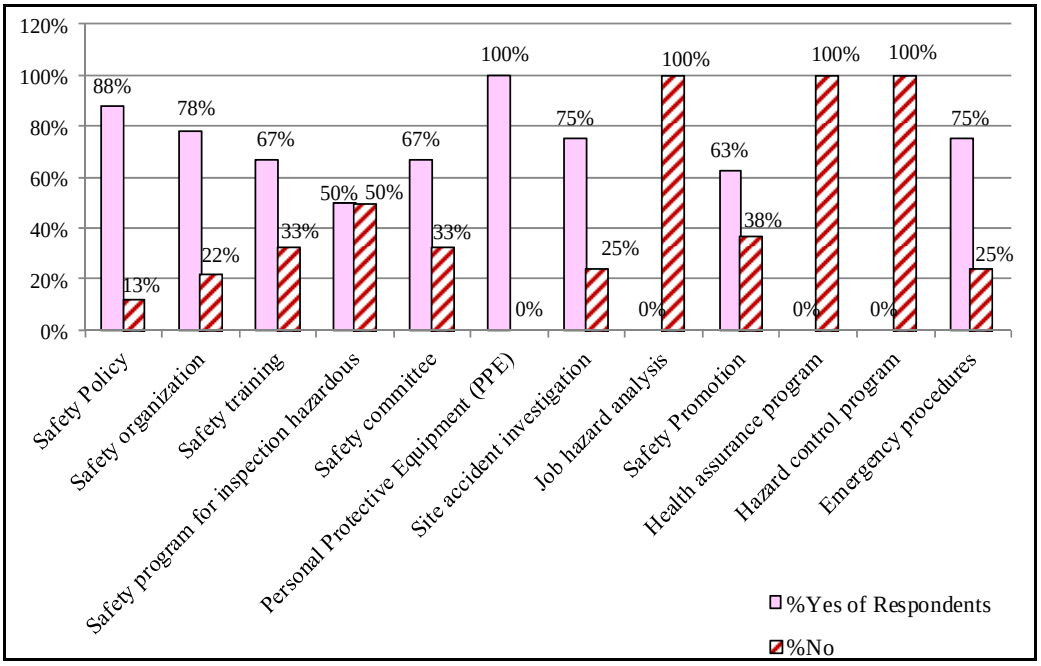

Figure 5.4 Results of current status of safety management, international contractors

As mentioned in Table 5.2 and Figure 5.4 above, more details of each element will be explained as following paragraph:

Safety policy: From results above, 88% of the respondents claimed that the companies have their own safety policy. The international contractor companies now consider the implementation of health, safety and environment management system as an important part of all site procedures. It is in company's safety and health requirement of policy in questionnaire 1.a. The companies have committed themselves to meet the minimum requirements all pertinent health and safety legislation (1.b). (1.c) the company's policies require having safety procedures and manuals at construction sites by implementing following policies of international contractors. The local companies have to ensure that policy is one of the subjects need to provide safety training to new employees. The project managers said that 67% of international contractors assigned safety engineers to new employees aware of the safety policy during their training and orientation (1d). (See Appendix H, evidence of safety policy)

***Safety organization*:** On each project, it is necessary to display site organization charts on the notice board indicating responsible safety advisors for every section of projects. 78% of project managers have claimed that they conduct the implementation

of safety organization in their international firms. A project safety organization chart should be included in the site safety plan for each project as (2.a), 83% of local project managers said that organization chart have been used in companies. As question 2.b was 83% of project managers' respondents, the individual health and safety responsibilities should be assigned to workers by documents and orientation training courses. 67% of project managers of international companies intend to update safety information, code of practices and works procedures as 2.c.

***Safety training*:** 67% of the respondents claimed that safety training had been provided to workers at job sites, while 33% is in contrast. Interviewees show that 50% of the international companies have established a safety health and training plan in which workers are provided training (3.a). 83% project managers have provided all the employees the basic or site specific safety training (3 times per week) before starting work at site as in question 3.b. (see Appendix H, evidence of safety training).

***Safety program for inspection hazardous*:** 50% of interviewees have no conducting for safety inspection hazardous. As mentioned in question 4.a, 0% of respondent said yes. So the international contractors have not made adequate preparation to control the efficiency of safety inspection. The companies should ask to instruct to review the usefulness and carefulness of the site safety inspections by carrying out the strict monthly audits. Safety officers should conduct weekly inspection of all zones, record the results, and take helpful action to be sure site safety as in 4.b. 83% of project managers said yes that safety officer should carry out safety inspection at regular intervals. As mentioned in 4.c, 67% said, yes, in the appropriate arrangement to collect and analyze the results of safety inspections. It means that the project managers do not enough pays regular attention to the analysis of safety inspections.

***Safety committee*:** 67% of respondents have set up the safety committee. As 5.a, 67% of interviewees said that their companies are not well enough set up to identify, to recommend and to review measures to evaluate in order to improve the safety and health at sites. But they have a group meeting or committee in construction sites as 100% international project managers said (5.b). This meeting is just to remind all employees to pay attention on operation or process of each site work. (See Appendix H, evidence of safety meeting).

***Personal protection equipment*:** 100% of the respondents said that all international contractor firms ask employees to use PPE during working at site (6.a). 100% of international contractors claimed that they have a procedure to check appropriately used PPE by worker on sites as 6.b, and they do this to avoid injuries from correctly using PPE, so safety officers have to check and monitor of using of PPE. As shown in 6.c, 100% of interviewees claimed that they have the procedure to ensure the proper use of PPE by workers at construction sites. (See Appendix H, evidence of PPE).

***Site accident investigation*:** 50% of project managers have said that they have conducted the incident injuries investigation in construction sites (7.a). Moreover, 100% of respondents claimed that they have the accident reports for accident occurring at site. (See Appendix H, evidence of accident reports form).

***Job hazard analysis*:** 0% of the respondents have conducted the job hazard analysis in construction sites, while 100% is in contrast.

***Safety promotion*:** as 9.a, 83% of project managers said yes. Companies are following good practice by displaying safety material on safety bulletin boards so that employees can read and understand them during working day. The project managers should display site accidents statistics on safety bulletin boards or distribute directly information to workers but only 17 % of project managers have displayed this information to employees (9.b). 100% of interviewees said yes, so it is the good practice that the international companies displayed safety signs and posters near work areas to improve defensive measures (9.c). The contractor companies should organize best safety site rivalry, best safe worker competition by publishing results of estimation surveys of staff on safety in the twice-yearly bulletin, but 50% have done this (9.d). (See Appendix H, evidence of safety sign, and notice board).

***Health assurance and hazard control program*:** as in question 10.a, 100% of international contractors have not conducted the health assurance program at construction sites in order to protect workers from many types of incidents happening by chance. Moreover, 0% of interviewees said that their companies have conducted hazard control program while 100% don’t have this kind of program (11.a).

***Emergency preparedness*:** generally, each construction site needs to prepare several types of emergencies before the project starts. They do this in order to avoid a

lot of unexpected accidents, for improving safety and evacuate the employees from incidents. As 12.a, 50% of interviewees as project managers have the emergency exit at jobsite while working such as siren or alarm system. Moreover, 100% of respondents of international contractor firms have published and posted list of emergency contact as police station number, hospital telephone or sign as emergency exit, and sign for telling the meeting place for evacuation of employees at the construction sites. (See Appendix H, evidence of emergency exit and contact list).

Table 5.3 Current status of safety management both local (Medium company) and international contractors (Large company)

Items to evaluate status of safety management	**International contractors**		**Local contractors**	
	%Yes	**%No**	**%Yes**	**%No**
Safety Policy	88%	13%	44%	56%
Safety organization	78%	22%	25%	75%
Safety training	67%	33%	33%	67%
Safety program for inspection hazardous	50%	50%	11%	89%
Safety committee	67%	33%	23%	77%
Personal Protective Equipment (PPE)	100%	0%	61%	39%
Site accident investigation	75%	25%	46%	54%
Job hazard analysis	0%	100%	8%	92%
Safety Promotion	63%	38%	49%	51%
Health assurance program	0%	100%	13%	88%
Hazard control program	0%	100%	8%	92%
Emergency preparedness	75%	25%	46%	54%

Remark: %Yes: percentage of project managers of contractors carrying out each element of safety management, %No is in contrast.

Based on table above, international contractor firms is better carried out each elements of SM than local contractor firm; however, job hazard analysis, health assurance program and hazard control program in local companies is carried out by local contractors better than international contractors, because during interviews some local contractors have done projects of foreign investors (e.g. Japan: JICA as owners) that requires contractors start projects with high safety standard.

5.3 Identify factors influencing safety management in Cambodian construction

Fifteen factors affecting safety management (SM) got from literature reviews and experts' opinion have been used to identify the factors influencing safety management in the Cambodian construction sites. For more details see the form questionnaire how to identify factors as shown in Appendix A and data analysis of finding factors as illustrated in Appendix E.

As mentioned in Figure 5.5, these findings indicate that there are only nine factors of 15 factors that affect safety management in construction sites in Cambodia. Influencing factors have been analyzed by the average percentage of respondent answers both local and international contractor companies. The factors that have average as percentage less 50% of the interviewees must be cut out and they are not important factors influencing safety management in Cambodia. Figure 5.5 has shown the results of research finding on factors affecting safety management.

Each factor affecting safety management in local and international contractor companies are shown in Appendix E, Table E3.

Table 5.3 Nine factors influencing safety management over 50% PMs' opinion

No	**Factors affecting safety management**	% of interviewee's opinion factors influencing
1	Cost or Budget	77%
2	Safety policy	58%
3	Awareness of Project manager/Safety manager	73%
4	Safety training	75%
5	Safety organization	69%
6	Safety regulation	67%
7	Personal Protective Equipment	60%
8	Site accident/incident investigation	54%
9	Safety committee	50%

As illustrated in Table 5.3, it describes clearly 9 factors influencing SM in Cambodia, from both local and international contractors firms as cost or budget, safety policy, awareness of project managers, safety training, safety organization, safety regulation, personal protective equipment, site accident/incident investigation, and safety committee.

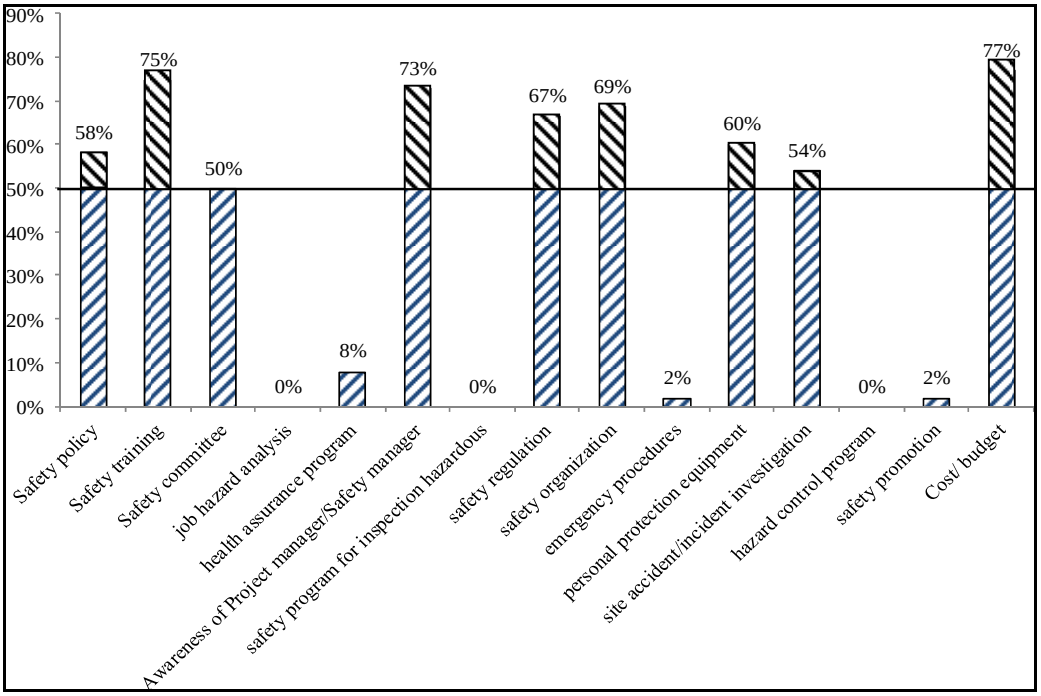

Figure 5.5 Results of factors influencing safety management, both local & international contractors

5.4 Cause-effect diagram of safety management in Cambodia

As shown in Figure 5.6, all factors affecting safety management have been used to find the causes of those factors affecting and problems of each factor. To improve safety management in the Cambodian construction sites, the form of questionnaires has been designed by incorporating 9 influencing factors. For more details of questionnaire form and results of them are demonstrated in Appendix B and Appendix F, in order.

This survey was conducted by interviewing 20 projects managers of contractors. There are a lot of causes of factors affecting and also many problems impacted by those factors to construction sites safety management in Cambodia.

As mentioned in Table 5.4 to Table 5.12, these tables indicate the results of the problems and causes of nine factors affecting safety management.

In addition to results from those answer to questions why in tables on the next page and to more easily understand the cause of those factors affecting construction sites safety management, the cause-effect diagram has been used to present the results as seen in Figure 5.6.

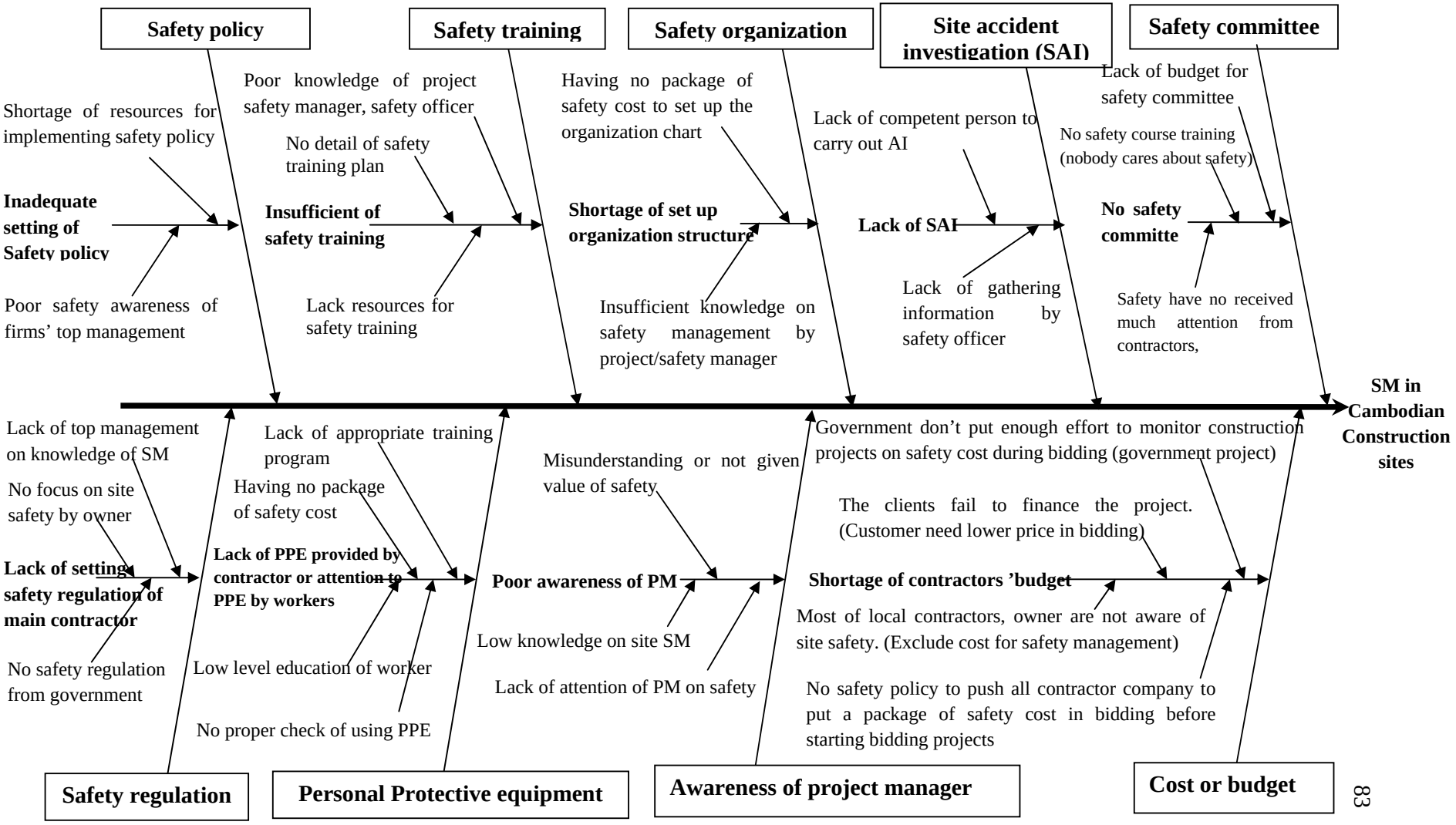

Figure 5.6 Cause-effect diagram of factors affecting SM

Table 5.4 Results of cause of cost/budget problems affecting safety management

Problem items: A. Cost or Budget		***Project managers (PM) (Number of respondents)***	***PM (%)***
Shortage of constructors'budget, Lack of budget(minimize cost in building)			
Cause No	*Why does lack of cost/ Budget for safety management in construction sites?*		
WA1	Due to the clienct failing to finance the project (most customers need the lower price in bidding), some project do not put amount of money for bidding on safety in construction (Reduce cost)	20	100%
WA2	Government does not put enough effort to monitoring construction projects on safety cost during bidding (government project),(lack of involvement of local government)	18	90%
WA3	No safety policy to push all contractor companies to put a package of safety cost in bidding before starting bidding projects by following some standards such as ISO or OSHA.	19	95%
WA4	Most of the construction building projects in Cambodia, local owner and main contractors not aware of site safety (not include cost for safety management)	20	100%
Effecti -ng No	*How does lack of cost/budget influence safety management in construction sites?*	***Projects managers (number of respondents)***	PM (%)
HA1	Contractors can not buy or support materials and arrange the safety team or safety organization	20	100%
HA2	Can not set up the safety management well (exclude some elements of safety management)	17	85%
HA3	Low resources for safety on site or shortage of safety facilities	19	95%
HA5	Poor safety conscientiousness of workers (in case of having no incentive, etc)	11	55%
HA6	No safety inspection	14	70%
HA4	Lead to accident in construction sites	15	75%

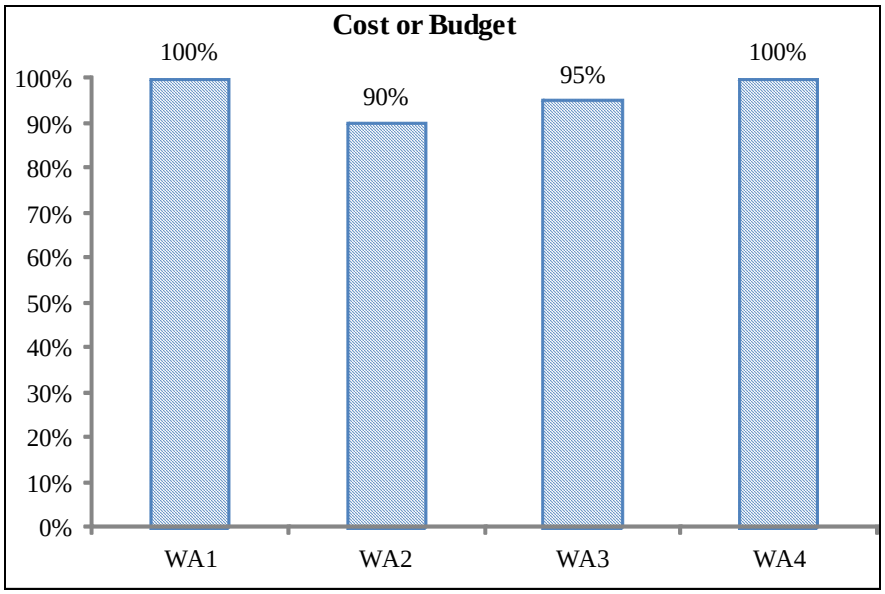

Figure 5.7 Percentage of PMs' opinion on cause of budget problems

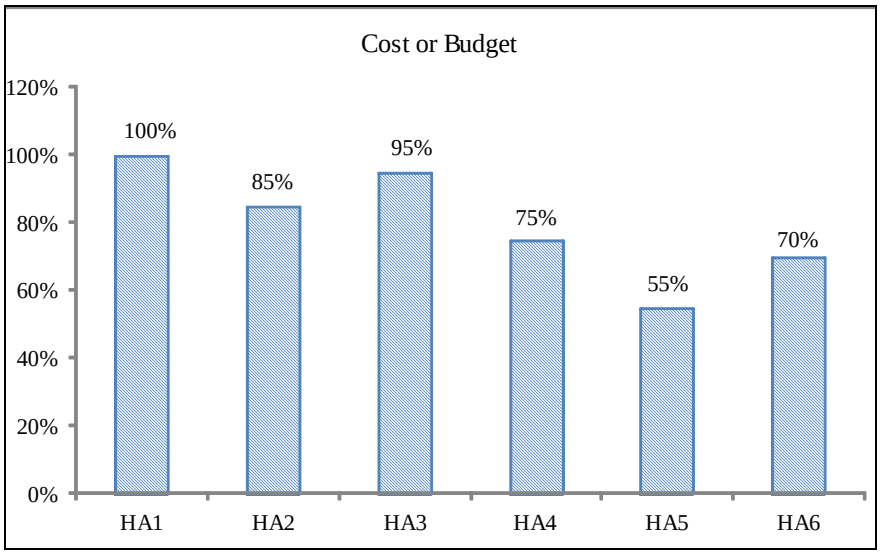

Figure 5.8 Percentage of PMs' opinion on effecting of budget problems

As mentioned in Table 5.4, Figure 5.7, Figure 5.8, the causes and the problems of cost or budget are explained as follows:

Cost or Budget: safety cost or budget is most important point to set up safety management plan for construction firm. Without cost or budget, the construction companies must exclude safety in the process of work task at sites. Moreover, shortage of safety cost or contractors' budget is the main affecting factor on safety management in construction sites. There are many reasons for lack of safety cost such

as the clients fail to finance the projects by excluding safety cost in bidding projects (customer need the lower price in bidding projects), lack of involvement of government by government not putting enough effort into monitoring construction projects on job safety management during tendering, no regulation to force all construction companies to include package of safety cost in bidding project on safety management, and in most of the construction projects in Cambodia, local owner and contractors do not pay much attention on safety management which is why they do not include safety cost in bidding, in order to get the projects. According to this, lack of safety cost will lead to many problems on safety management in construction sites. Contractors can not buy enough safety equipment or support materials in construction sites. Contractors find it hard to arrange safety team and set up the safety organization to implement the safety procedure at job site due to safety cost. Low resources for safety on construction sites, no safety inspection due to the lack of safety cost, so can not hire engineers or foremen to do job site inspection. The elements of safety management must exclude some of them, can not implement all and this will lead to accidents taking place at workplace because no safety cost, safety training, job site inspection will be absent. All workers have poor safety conscientiousness on operation job task at sites because rewards, gift are absent, and nobody reminds them to pay more attention in each job task at sites.

As mentioned in Table 5.5, Figure 5.9, and Figure 5.10, it describes the causes and problems of safety policy affecting safety management in construction site in Cambodia.

Table 5.5 Results of cause of safety policy problems affecting safety management

Problems items: B. Safety Policy		***Projects managers (Number of respondents)***	PM (%)
Inadequate of setting of safety policy:			
Cause No	Why does lack of setting *Safety policy* for safety management in construction sites?		
WB1	Due to shortage of resources for implement-ing safety policy	20	100%
WB2	Due to poor safety awareness of firms' top management	18	90%
Effecting No	How does lack of setting *Safety policy* influence safety management in construct-ion sites? (what are the Problems)	***Projects managers (number of respondents)***	
HB1	Hard to control or arrange all safety teams	20	100%
HB2	Many accidents can be took placed in construction sites	13	65%
HB3	Not enough implementation of safety policy by safety organization	18	90%
HB4	Procedure of working will be missed or undefined the minimum requirement of safety starndard	18	90%
HB5	No safety inspection, Accident and juries whenever the safety policy is not strict or not well prepare	16	80%

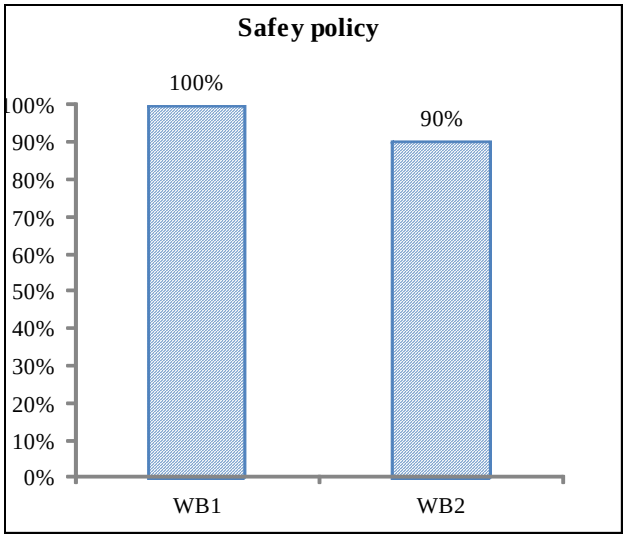

Figure 5.9 Percentage of PMs' opinion on causes of safety policy problems

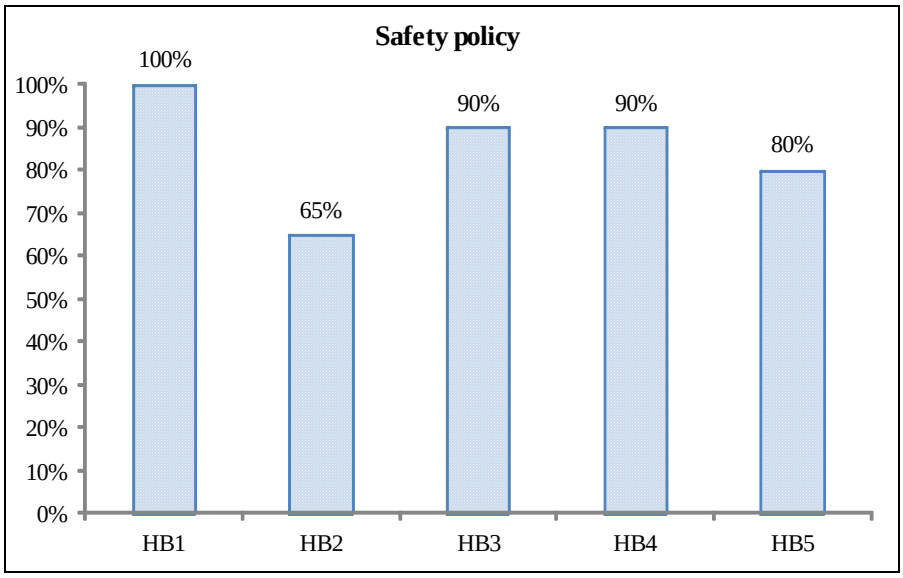

Figure 5.10 Percentage of PMs' opinion on effecting of safety policy problems

Safety policy: Managing Director sign and commit the policy statement of health and safety. It should be presented in a visible workplace. Communication must be carried to every operational level of employees who have to understand safety commitment at job site. The effective safety policy sets a clear direction for organization to follow. Safety policy is one of the factors influencing safety management in the Cambodian construction sites in case of the company having inadequate setting of safety policy. The cause of inadequate setting of safety policy is the poor safety awareness of firms' top management and the shortage of resources to implement it. Poor safety awareness of firms' top management is due to the Cambodia nowadays not having safety training school, and no safety regulations or standards. Shortage of resources to implement safety policy is due to the budget. There are many problems that can take place if the safety policy is inadequately set up in company; hard to control or arrange safety team: missed communication or understanding the objective of safety policy (unclear goal). The procedure of works at job sites will miss the minimum requirement of safety standards because safety organization might not well enough implement safety policy. It can be absent safety inspection, and accidents, injuries happen by chance whenever operation of machine, equipment is in the wrong way.

As mentioned in Table 5.6, Figure 5.11, and Figure 5.12, it describes the causes and problem of safety training affecting safety management.

Table 5.6 Results of cause of safety training problems affecting safety management

Problem item: C. Safety training		***Projects managers (number of respondents)***	PM (%)
Insufficient safety training			
Cause No.	*Why does lack of Safety training for safety management in construction sites?*		
WC2	Due to Poor safety knowledge of projects safety managers, safety officers	20	100%
WC3	Due to No detail of safety training plan	17	85%
WC4	Due to No resources for safety training	18	90%
Effecting No	*How does lack safety training influence safety management in construction site?*	***Projects managers (number of respondents)***	
HC1	Accidents in construction sites when they don't know how to use equipment correctly	18	90%
HC2	Failure to operate machines and equipment properly or lack of understanding of job procedure	17	85%
HC3	Hard to manage in work place safely	13	65%
HC4	Project start is not smooth or can be late (leads to not succeeding in implementation of SM)	19	95%
HC5	Lack of skilled workers (lack of providing safety training to employees, or not enough safety induction to workers)	18	90%

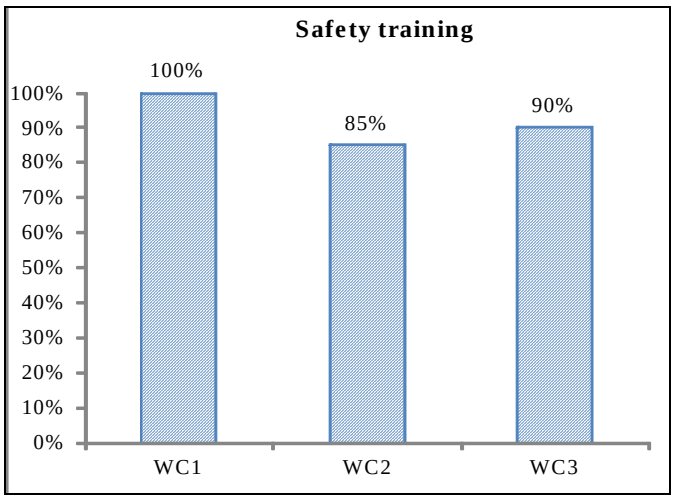

Figure 5.11 Percentage of PMs' opinion on causes of safety training problems

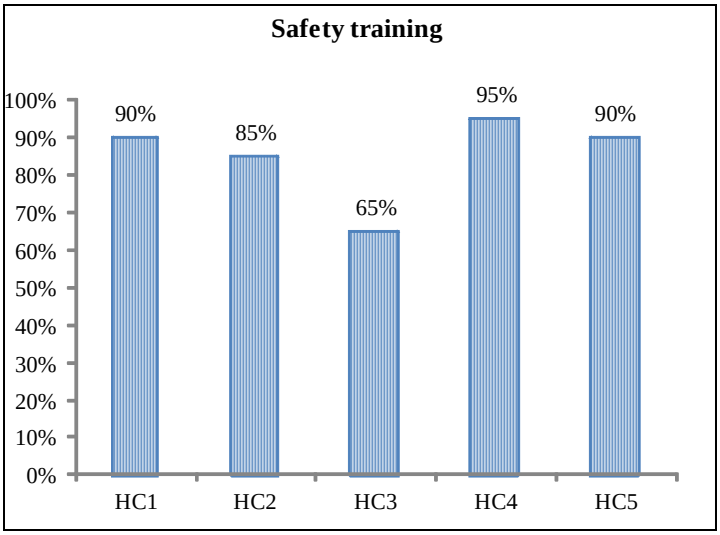

Figure 5.12 Percentage of PMs' opinion on effecting of safety training problems

Safety training: safety training is important for improving safety performance at construction sites. To ensure workers' safety at job site, all employees must receive appropriate safety training in all work procedures before starting work activities such as basic safety training, small space training, welding safety training. Safety training program is required all workers to attend safety induction courses, specific job training, learning from past accident. Staffs who have not received safety training are not allowed to implement work in construction sites. Moreover, safety training is one of the affecting factors in case of insufficient safety training by contractors. No detail safety training plan, poor knowledge of project safety managers/safety officer, no resources for safety training, all of these is the main reasons leading to lack of safety training. Poor knowledge of project managers because in Cambodia there is not much attention on safety management, and other way is that safety training course is absent in school in Cambodia. So it leads to have no detailed safety training plan. In bidding project, safety cost has been cut out so there are no recourses for safety training. The causes of this factor in construction sites will have problems as employees fail to operate machine, equipment properly, and misunderstand job procedures; lack of skilled workers by having not enough safety training to employees; it is hard to manage work safely; project starts is not smooth (not succeed in implementing of SM at workplace); and many accidents/injuries at construction sites occur when employees do not know how to use or operate equipment correctly.

Table 5.7, Figure 5.13, and Figure 5.14 describe the causes and problems of safety organization affecting safety management in Cambodia.

Table 5.7 Results of cause of safety organization problems affecting safety management

Problem item: D. Safety Organization		***Projects managers (number of respondents)***	PM (%)
Shortage of setting up the organization structure			
Cause No	Why does shortage of set up *Safety organization* for safety management in construction sites?		
WD1	Due to having no package of safety cost to set up the organization chart	18	90%
WD2	Due to the insufficient knowledge on safety management by project/safety managers	19	95%
Effecting No	How does lack of s*afety organization* influence safety management in construction sites?	***Projects managers (number of respondents)***	
HD1	Difficult to control safety team in construction sites	14	70%
HD2	Hard to manage work safely in site (site engineering responsible for all part of safety)	16	80%
HD3	Lack of implementation of safety policy	16	80%
HD4	No safety engineers to keep up to date with recommended new code of practice and all information applicable to employees	5	25%
HD5	No safety teams to monitor weather the worker fail to use or not use their safety tool (no safety inspection to check the safety performance)	19	95%

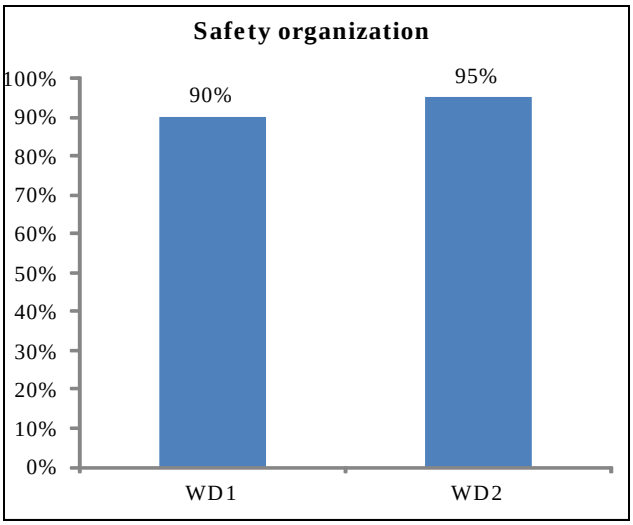

Figure 5.13 Percentage of PMs' opinion on causes of safety organization problems

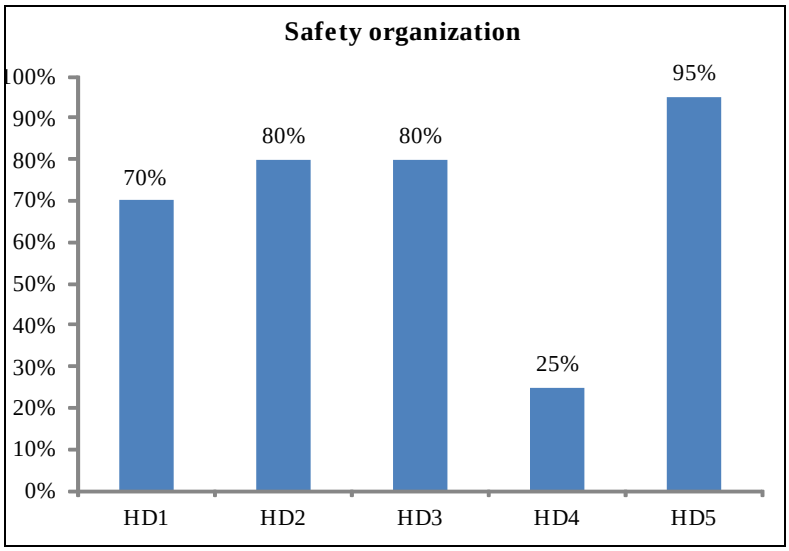

Figure 5.14 Percentage of PMs' opinion on effecting of safety organization problems

Safety organization: constructors firms should create an organization structure from management to every working level of workers. It includes foremen, workers, supervisors have to be provided the induction courses such as introduce new equipment, new technology. The obligations and tasks of each worker's level must be well defined. So that everybody can understand the safety policy and follow safety process at work sites. Shortage of setting up organization structure is one of the affecting factors on safety management. The lack of setting up organization chart because companies have no package of safety cost to set up organization structures,

and it can come from the insufficient knowledge of project managers on safety management. Safety cost has been excluded in bidding project which is why companies do not have safety cost to set up organization. Knowledge of project managers is insufficient due to training safety courses. Meanwhile, there are many problems that can occur because of this. It is difficult to control safety teams in construction sites and hard to manage work safely at site because one site engineer can be responsible for all site safety. It must be lack of implementation of safety policy and no safety engineer to keep date with suggested new code of practice and all information applicable to employees. Moreover, there are no safety teams to monitor weather workers fail to use their safety tools, due to having no safety inspections.

Table 5.8, Figure 5.15, and Figure 5.16 describe the causes and problems of PPE affecting safety management in Cambodia.

Table 5.8 Results of cause of personal protection equipment problems affecting safety management

Problem item: E. Personal Protective equipment Lack of PPE provided by contractor or lack of attention to personal safety protection by worker		***Projects managers (number of respondents)***	PM (%)
Cause No	Why does lack of *personal protective equipment* for safety management in construction sites?		
WE1	Due to the low cost or having no package of safety cost, (company provide not enough PPE to worker)	18	90%
WE2	Lack of appropriate safety training program	8	40%
WE3	Low level education of workers	15	75%
WE4	No proper check or control of using PPE during working process	17	85%
Effecting No	How does lack *personal protective equipment* influence safety management in construction sites?	***Projects managers (number of respondents)***	
HE1	Many cases of accident can occur (e.g. Falling from height, head damage	17	85%
HE2	Stop working at site for a while in case of incidents occurring by chance	18	90%
HE3	PPE affecting cost of material, high price	15	75%

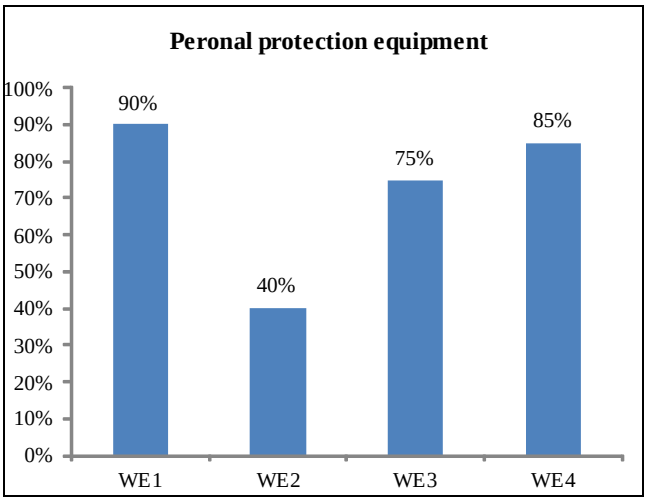

Figure 5.15 Percentage of PMs' opinion on causes of PPE problems

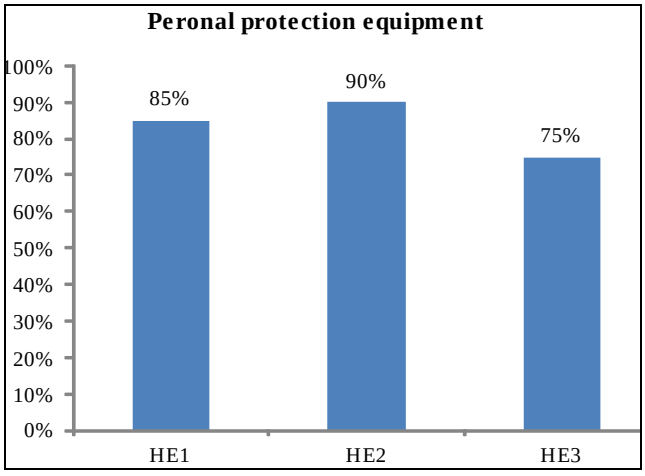

Figure 5.16 Percentage of PMs' opinion on effecting of PPE problems

Personal Protective Equipment: work procedures must be well identified and classified to meet the minimum relevant legal requirement on the use of personal protective equipment. Selection of approval safety personal protection equipment is required to ensemble the particular classification of the work activities. Selection, issuing, monitoring, maintenance, replacement must be well keep in track records. As in example, there are several types of PPE such as safety shoes, helmets, eye protection, respirators, and safety gloves. Personal protection equipment must be one of the factors affecting safety management in case lack of PPE provided by contractors or lack of attention to personal safety protection by workers. Several reasons for lack of PPE or attention of workers using PPE are: no safety cost to buy

PPE; lack of appropriate training program and low level education of workers; and it has no proper check to control properly used of PPE during working process. Meanwhile, many cases of accidents can be occurred such as failing from height, head damage in case not wear safety helmets, and so on. The work process on construction sites can be stopped due to the serious accidents or death of persons at sites. Moreover, the personal protection equipment is affected by cost of material (high price of PPE).

As mention in Table 5.9, Figure 5.17, and Figure 5.18, it describes the causes and problem of safety training affecting safety management in Cambodia.

Table 5.9 Results of cause of safety regulation problems affecting safety management

Problem item: F. Safety Regulation		***Projects managers (number of respondents)***	PM (%)
Inadequate safety regulation of main contractors			
Cause No	Why does lack of *Safety regulation* for safety management in construction sites?		
WF1	Due to no safety regulation from government to force contractors to set up clear safety standards	16	80%
WF2	Due to the top management lack of knowledge of safety management	18	90%
WF3	The most companies have no safety standard (just copy some parts of safety from various sources and implement in construction sites)	19	95%
WF4	Non strict and not focus on site safety by owners or consultants	13	65%
Effecting No	*How does lack of safety regulation influence safety management in construction sites? (what are the Problems)*	***Projects managers (number of respondents)***	
HF1	Lack of strict operation procedure	20	100%
HF2	Hard to force safety team to do work	10	50%
HF3	Accidents often take placed, while having no safety procedures or manuals	5	25%
HF4	No clear requirement standards for some kinds of job	7	35%

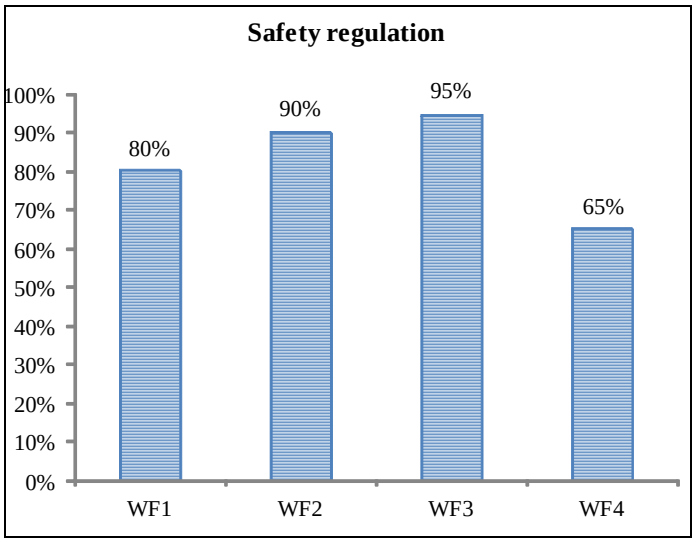

Figure 5.17 Percentage of PMs' opinion on cause of safety regulation problems

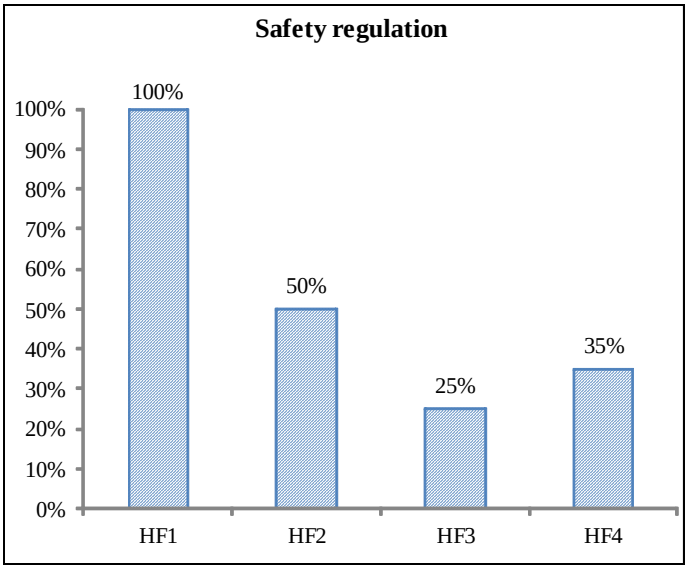

Figure 5.18 Percentage of PMs' opinion on effecting of safety regulation problems

Safety regulation: it is very important for company to set up safety regulation and which regulations or safety standards will be followed by contractors. The safety regulations play a vital role in shareholder as contractors, owner, consultants and government. Safety regulation has to be well defined by shareholder, and they have to state clearly which standard will be implemented. Safety regulation must be affected safety management in construction sites in case lack of setting up safety regulation by main contractors. The inadequate set up of safety regulations can be from top management of contractors' lack of knowledge of safety management; no regulation

from government to force contractor to set up clear safety standards; and the owner not focused on site safety (not strict on safety). There are many problems that can occur as, it is hard to force safety teams to do work; lack of strict operation of work procedures; there is no clear requirement standards for some kinds of job, accidents often take place.

Table 5.10, Figure 5.19, and Figure 5.20 describe the cause and problems of awareness of project manager affecting safety management.

Table 5.10 Results of cause of awareness of PM problems affecting safety management

Problem item: G. Awareness of project manager/safety manager Poor awareness of project managers or safety managers by contractor		***Projects managers (number of respondents)***	PM (%)
Cause No	Why poor a*wareness of project manager/safety manager* for safety management in construction sites?		
WG1	Low knowledge on safety management in construction sites	18	90%
WG2	Lack of attention of project managers or safety managers of contractors	15	75%
WG3	Misunderstanding and not give value of safety on construction sites	15	75%
Effecting No	How does poor *Awareness of project manager/safety manager* influence safety management in construction sites? (what are the Problems)	***Projects managers (number of respondents)***	
HG1	Accidents easier to reoccur, and hard to manager or implement SM	20	100%
HG2	lead to failure of project safety management system (lack of carrying out of work task on site)	13	65%
HG3	Process of management on site safety is not good (miss of implementation of safety policy)	15	75%
HG4	Fail to carry out site inspection, liaise with the person in charge of works.	6	30%
HG5	Lack of review and update safety plan based on the process of projects	13	65%
HG6	Not clearly defined safety policy, hard to manage and organize the safety team	17	85%

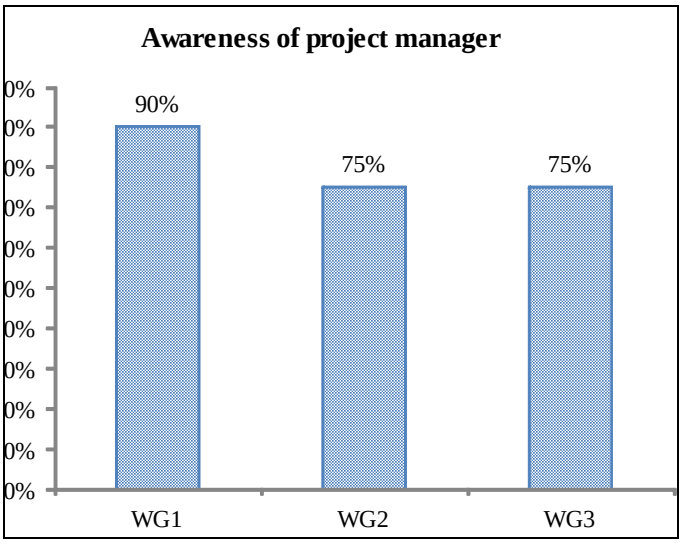

Figure 5.19 Percentage of PMs' opinion on causes of awareness of PM problems

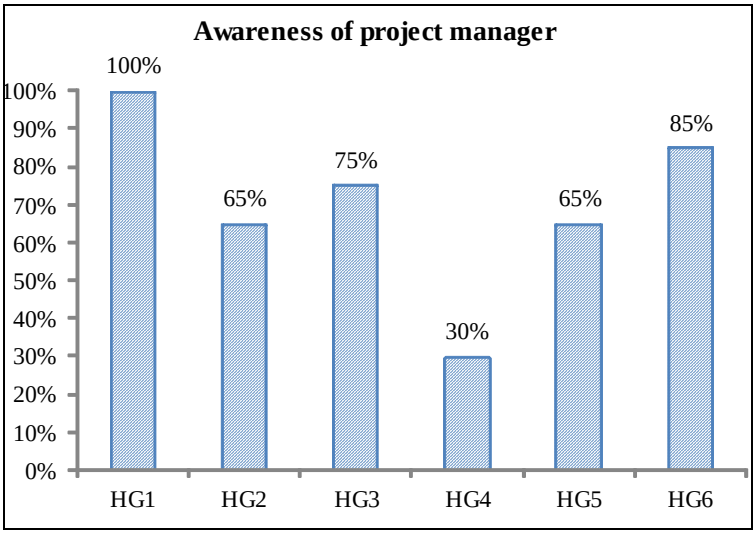

Figure 5.20 Percentage of PMs' opinion on effecting of awareness of PM problems

Awareness of project manager/safety mangers: knowledge of project /safety manager of contractors is necessary for implementing health and safety management at construction sites. They assure better implementation all components of safety management system such as safety policy, safety training, safety organization, PPE and so on. Projects/ safety managers are the key persons leading to project success by implementing safety procedures, job site inspection, safety management plan, without failure or risk to health and safety at workplace. Poor awareness of project/ safety managers is one the affecting factors on site safety management. There are some reasons of poor awareness of project managers such as low knowledge on safety

management in construction sites (no school in Cambodia taught about safety), lack of attention of project managers of contractors to safety management, and not give value on safety at construction projects. In addition, poor awareness of project manager will lead to many problems occurring such as lack of review and updated safety plan based on the process of projects, lack of implementing safety policy, failure to carry out site inspection or communicate with person in charge of works, safety policy is not clearly set up, leading to failure of project safety management and accidents are easier to re-occur.

Table 5.11, Figure 5.21, and Figure 5.22 describe the causes and problem of site accident investigation affecting safety management in Cambodia.

Table 5.11 Results of cause of site accident problems affecting safety management

Problem Item: H. Site accident/ incident investigation		***Projects managers (number of respondents)***	PM (%)
Lack of site accidents/incident investigation:			
Cause No	Why does lack of *site accident/incident investigation* for safety management in construction sites?		
WH1	Don't have the competent person to carry out accidents investigation	20	100%
WH2	Lack of gathering information by safety officers	15	75%
Effecting No	How does lack of *site accident/incident investigation* influence safety management in construction sites?	***Projects managers (number of respondents)***	
HH1	The accident can re-occur (no investigation)	18	90%
HH2	Lost or damaged properties	20	100%
HH3	Can not find the source/causes of accidents	15	75%

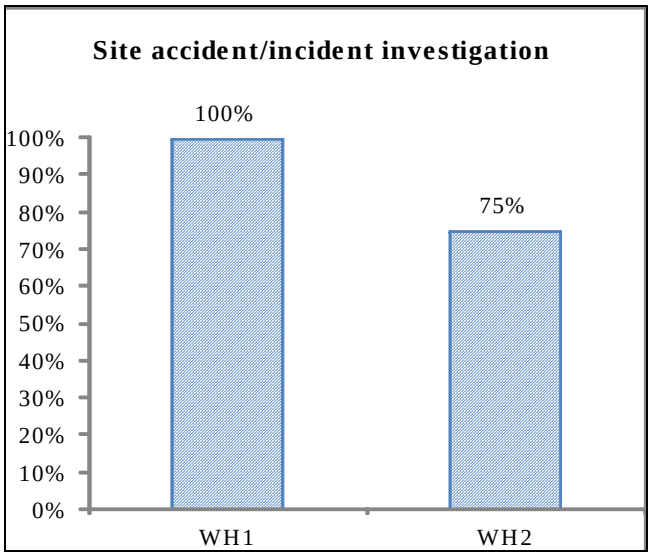

Figure 5.21 Percentage of PMs' opinion on cause of accident investigation problems

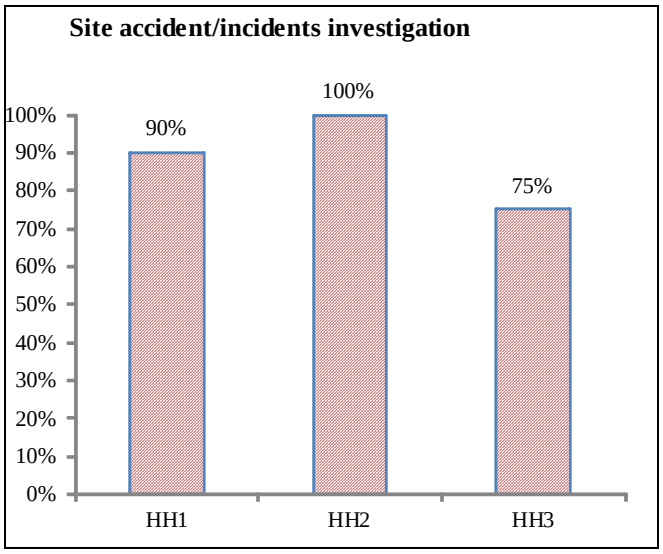

Figure 5.22 Percentage of PMs 'opinion on effecting of accident/incident investigation problems

Site accident/incident investigation: a working team should be formed to investigate incident and accident. All near miss, incident, minor injuries, and accident must be reported for statistical analysis, review, learning from experiences. A reporting procedure must be carried to employees and controlling staff. A safety model should be used for analysis of the accidents. Safety management should review the accident for preventing reoccurrence. Lack of site accident investigation is one factors affecting safety management in construction sites. The company has no

competent person to carry out accident investigation, and also lacks gathering information by safety officers, are the source of lack of site accident investigation. Based on this, the contractor company will face some problems such as the reoccurrence of accidents; properties lost, and can not find the sources of accidents.

Table 5.12, Figure 5.23, and Figure 5.24 describe the causes and problem of site safety committee affecting safety management

Table 5.12 Results of cause of safety committee problems affecting safety management

Problem item: I. Safety committee		***Projects managers (number of respondents)***	PM (%)
No or lack of safety committee			
Cause No	Why does lack *safety committee* for safety management in construction sites?		
WI1	Due to no budget for safety committee	20	100%
WI2	Due to no safety courses training (nobody know or care about safety)	18	90%
WI3	Due to safety have no received much more attention from contractors, owners, and consultants	20	100%
Effecting No	How does lack of *safety committee* influence safety management in construction sites?	***Projects managers (number of respondents)***	
HI1	No evaluation, no committee to check implement of safety management performance	20	100%
HI2	Lack of reviewing, recommending or editing by safety committee	20	100%
HI3	Without valuating or monitor from safety committee, safety manager or project manager can do what they want to do at site on safety, they're concerned only their profits and they will not be strict on site safety	18	90%
HI4	lack of monitoring safety policy leads to determine whether it is adequate and how well it is being implemented	19	95%

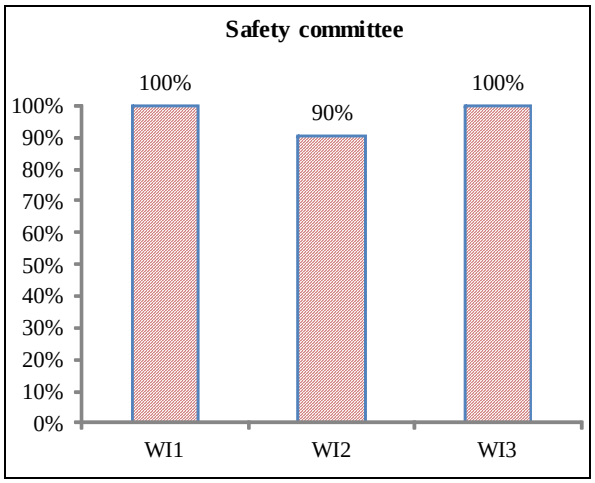

Figure 5.23 Percentage of PMs' opinion on cause of safety committee problems

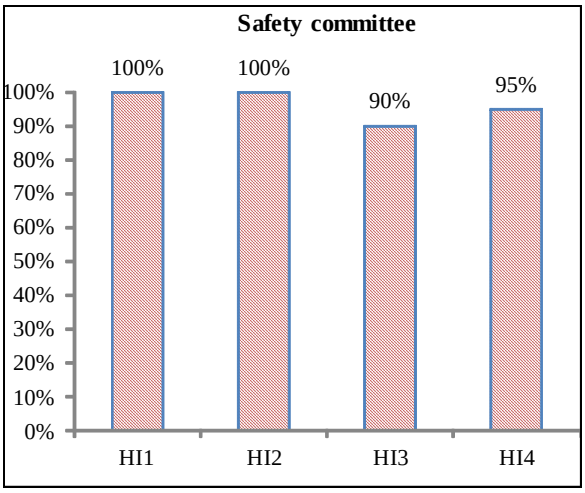

Figure 5.24 Percentage of PMs' opinion on effecting of safety committee problems

Safety committee: safety committee should be established and a regular safety meeting is to be carried at all construction sites. The members' structure must consist of contractors' management, workers' agents, and representative of government agenda is possible. The agenda must center on implementation of safety issue, performance, problems, trainings, promotions, suggestion, incidents, and recommendation, and review working procedure on construction activities, legal requirements. Lack of safety committee must affect construction site safety management. Safety committee in construction sites is lacking because companies have no budget to set up committees; safety training courses (nobody cares about safety); and safety has not received much attention by contractors, owners, and consultants. Without safety committee, contractor will face some problems such as

lack of reviewing, recommending, no committee to check implementation of safety management performance, and lack of monitoring of safety policy, leading to determine whether it is adequate or not and how well it is being implemented.

5.5 Recommendations for improving safety management in the Cambodian construction sites from contractors' viewpoint

Safety is subject which has not received much attention or enough support from owners, consultants, contractors, governments and it also requires more resources and cost for safety tool such as materials, equipment or machines.

According to the analysis of data collection, the results and information were gathered from site observations, interviewing with project managers both local and international contractors; moreover, the in-depth interviewing with experienced contractors, who work in Cambodia, to get the knowledge in order to know how to improve safety management in construction sites. The experiences of in-depth interviewees were respectively 1) three project managers, 2) one safety manager.

Therefore, we can provide a recommendation for improving safety management performance in the Cambodia construction sites as follows:

- Increase in safety cost or budget of contractors by considering cost for safety management, customer has to put amount of package of safety cost in bidding
- Increase in safety training and education (new employees have to be trained by safety officer)
- All contractors need to have well enough set up safety organization and have to conduct site accident investigation
- Government has to provide training courses to project managers about safety
- All contractors have to provide enough personal protection equipment to employees and remind them to pay more attention.
- All contractors have to have adequate setting of safety policy and well defined the objectives, goals, according to the health and safety standards
- The safety regulation have to be well defined by the contractors
- Safety committee shall be created and set up by the shareholder as consultants, contractors and it is better members of government can attend this committee.

Table 5.13 Problems or factors affecting SM and method for improving SM

Problems or Factors affecting SM	***Method for improving SM***
1. Lack of safety cost	1. Add safety budget by considering safety cost in bidding
2. Lack of safety training	2. Increase in safety training
3. Lack of PPE provided by contractors or lack of attention to personal protection equipment	3. Provide enough PPE to worker by contractors, education and remind employees to pay more attention every step of work procedure
4. Poor safety awareness of project manager	4. Increase in safety awareness of project managers/safety officers
5. Shortage of set up of safety organization	5. Increase in set up of enough safety organization
6. Lack of safety regulation	6. Increase in safety regulation
7. Lack of safety committee	7. Increase in safety committee
8. Inadequate setting of safety policy	8. Increase in setting enough safety policy
9. lack of site accident/ incident investigation	9. Increase in conducting site accident investigation

As mentioned in Appendix G, the summary of total recommendations that were proposed by 4 respondents is presented as the next page. Table 5.13 to Table 5.21 shows the results of recommendation from 4 respondents.

Table 5.14 Results of recommendation for improving SM (safety cost) in Cambodia from contractors' viewpoint

*Method for improving SM by adding safety budget, considering **safety cost** in bidding*	Number of Respondents
Government	
Government has to monitor construction projects on safety cost during bidding government projects	4
Before bidding, contractors are required to put amount of package of safety cost by owner, force by government	4
Owners	
Give priority to safety in construction by considering safety cost in bidding	4
Contractors	
Include package of safety cost in bidding in order to set up safety plan well	4

Table 5.15 Results of recommendation for improving SM (safety training) in Cambodia from contractors' viewpoint

*Method for improving SM by increasing in **safety training***	
Government	Respondents
Set up the school for specific safety training course for safety engineers and provide the certificate to those who have attended and completed courses requirement	4
Owners	
Owners have consultants to help to provide instruction and orientation to contractors on site safety	1
Contractors	
Employees should be provided basic or site specific safety training before starting work task at construction site and especially for the new workers	4
Engineers, top managers, safety officers	
Safety engineers, and safety management should attend courses of safety training provided by contractors, government	4
Ensure that all level staff received enough and appropriate safety training	4
Workers	
Workers have to attend training courses provided by safety officer, and join all activities of safety training	4

Table 5.16 Results of recommendation for improving SM (PPE) in Cambodia from contractors' viewpoint

*Provide enough **PPE** to worker by contractors, educate and remind employees to pay more attention every step of work procedure*	
Contractors	Respondents
PPE should be provided to workers enough, by contractors in order to prevent accidents from various activities	4
Set up position of safety engineer and assign them to train and educate worker by transferring the concepts of why they have to work safely and how unsafe act will affect them	4
Workers	
Use PPE correctly to prevent themselves from any accidents	4
Pay more attention related to work procedure, operation of machine	4

Table 5.17 Results of recommendation for improving SM (awareness of PM) in Cambodia from contractors' viewpoint

*Method for improving SM by increasing safety **awareness of project managers**/safety officers*	
Contractors	Respondents
Require all project manager or safety officer to focus on safety management and be aware on safety management	4
Assign safety officer or project manager to train on safety management course in foreign country or train with organization which has experience and knowledge on safety management	4
Project managers/Safety management	
Remind themselves and keep all past records on safety management plan, safety documents, and safety program of company to prevent some same mistakes happening again	4
Pay much attention to construction site safety management	4

Table 5.18 Results of recommendation for improving SM (safety organization) in Cambodia from contractors' viewpoint

Method for improving SM by increasing in set up of **safety organization**	
Contractors	Respondents
In order to succeed in implementing safety management, safety organization has to be well defined by top managers of contractors	2
Set up the position of each safety engineer, supervisor to their responsibilities	4

Table 5.19 Results of recommendation for improving SM (safety regulation) in Cambodia from contractors' viewpoint

Method for improving SM by increasing in **safety regulation**	
Government	Respondents
Cambodia has no safety regulation or standards, it is better that safety regulation, safety department shall be established by government (contractors, owners, consultants have to obey): safety books or rules to force contractors to give priorities to safety at construction sites	4
Contractors	
Top managers have to set up their own safety rules to control process of employees at sites	4

Table 5.20 Results of recommendation for improving SM (safety committee) in Cambodia from contractors' viewpoint

Method for improving SM by increasing **safety committee**	
Government	Respondents
Force owner to set up safety committee to control work tasks of contractors, report to government	1
Owners & consultants	
Set up the safety committee to evaluate the process of works done by contractors	4
Contractors	
Require having the safety committee in construction sites and have regular meeting with their members in site, and also with external member of owner representative	4
Conduct a small meeting around 15mn-30mn to remind workers on site safety, works procedures	3

Table 5.21 Results of recommendation for improving SM (accident investigation) in Cambodia from contractors' viewpoint

Method for improving SM by increasing in site ***accident investigation***	
Contractors	Respondents
Conduction site accident investigation to prevent from re-occurring	1
Engineers, safety officer, top managers	
Carry out site inspection, accident investigation to determine cause of any serious accidents occurring and recommend to corrective action	4
Workers	
Report any injuries, accidents at work to supervisors	4

Table 5.22 Results of recommendation for improving SM (safety policy) in Cambodia from contractors' viewpoint

Method for improving SM by increasing in **safety policy**	
Government	Respondents
Government should describe contract specification as guideline to control all risks of participations as asking name, hazard plan, safety standard that contractors will base work on to make project safe	1
Provide safety information regarding the proposal job, work task activities, safety representative to ensure site safety	2
Before starting new project, contractors have to contact first then submit documents as area location, building permitted	1
Owners & consultants	
Before bidding, the minimum requirement of safety policy submitted by contractors, must satisfy by owners	4
Hire consultant to evaluate contractors safety performance based on past record, safety documents and plant equipment	4
Require contractors to submit safety plan as information during tendering	1
Consultants have to control contractors by cutting some budget or stop contractors from doing job task in case contractors do work without following safety policy.	4
Contractors	
Before carrying out the activities, contractors need to submit projects of safety management plan to client	1
Give award to workers who work well on site safety	2
Warning worker who does work without following safety policy and stop them working at site in case 3 time of warning	1

As mentioned in Tables of recommendations above, from 4 respondents the summaries of suggestion for improving SM are described as the following:

Government: the government has to play a significant role at this stage to improve safety management performance at site.

1. Right now, Cambodia has no safety law or safety department, so it is better that the safety law and Safety Department in Cambodia (SDC) shall be established. Safety books or rules should be created by government to force the contractors, owners and consultants to give a priority to safety, to set a safety regulation for affecting the enforcement of safety on the job site.

2. Before bidding the projects, all contractors are required to have package of safety cost by owner, forced by government.

3. Cambodian government should set up school for specific safety training courses to all levels of engineers, and provide the certificate to someone who has attended and completed all courses requirement.

4. The government should provide certificates for contractors which well conduct safety management in construction projects, and withdraw or prohibit contractor companies which do not conduct safety procedures, or start construction project without respect for safety standards.

5. The government should provide safety statistics regarding the proposed job, work task activity, and safety representative to ensure workplace safety by leading site visits.

6. The government should require all contractors to contact first when starting a new project and submit compulsory documents such as building permit, area location.

7. To make project safely, the government shall describe contract specification as guidelines to control all risks of participations such as asking the name of who will respond to control the performance of contractors, should require all contractors to submit and prepare the acceptable hazard prevent plan, and also for the specific safety standards as what contractors will follow.

8. The government should force the owner to have the safety committee in order to evaluate the process of work done by contractors and make the review, recommend work activities, and report by safety committee to the government, all work processes done by contractors. In case that contractor has made mistake by death or serious

injuries, government can give blacklist to that contractors to stop working on construction project.

Owners and Consultants: owners act a very important part of reducing construction cost and rates of accidents occurrence.

1. A safety officer should be requested by owners at job site in contract documents. Owners have to meet the minimum requirement of safety policy that is provided by contractors before bidding.

2. Owners have to require the contractors (tenderers) to submit their safety management plan as information during tendering.

3. It is better that owner should hire consultant to prequalify contractors and value the contractors' safety implementation based on past safety record or performances, safety documentation, safety program of company, and plant equipment.

4. The consultants have to control contractors on safety by cut some budgets, or stop contractors' work in case that contractor does job without respecting safe policy, or contractors makes a huge mistake related to accidents as death.

5. Owners and consultants have to stress safety before starting the works. Owner should give a priority to safety management in construction building projects, by considering safety cost in bidding.

6. The owners have the consultants to help for providing instruction and orientation to the contractors on site safety.

Contractor firms: contractors are the important point to implement the safety management at construction sites and all processes of safety need to meet minimum requirement of safety standards.

1. Contractors should be required to submit the project safety management plan to the clients for approval before carrying out of the construction activities, so the contractors can implement their health and safety policy following the safety management system. Contractors should include package of safety cost in bidding in order to set up safety plan well.

2. Contractors should hire or set up safety inspectors and engineers to conduct at least weekly site inspections in construction projects. The inspections shall be

included the safety procedures, materials, and machine provided by contractor companies.

3. Personal protection equipment should be provided, to workers enough, by contractors in order to prevent accidents from various activities.

3. All employees should be provided by project manager or safety officer of contractors, basic or site specific safety training before starting work task at construction sites, especially for the new workers.

4. Site accident investigations have to be conducted by contractors to avoid re-occurrence.

5. Contractors should conduct a small safety meeting every morning around 15mn to 30mn to remind workers on site safety, work procedures and accidents that can take place.

6. The safety policy, safety regulation or standard, should be respectively arranged clearly by top management of contractors and a well define of safety organization were set up by contractors in order to succeed in implementing of safety management system.

7. Contractors should warn worker who has done work task without following safety policy or regulation by stopping worker from working in case of three time warning and safety promotions should be conducted by contractors, an incentive or gifts to workers, to make them enjoy working, and feel confident during working.

Engineers, top managers, and safety officers:

1. All engineers and safety management should attend courses of safety training provided by contractors, government, and they must transfer them to employees.

2. All engineers, safety officers have to make sure that they conducted working at site according to minimum requirement of standards or the safety policy of company.

3. They all have to ensure that all levels of staffs receive enough and suitable safety training.

4. And they also have to carry out site inspection, accident investigation, and determine the causes of any serious accident occurrences, to recommend to correct or to prevent from re-occurrence.

Workers: All employees should be aware of accidents which can take place by chance.

1. They have to attend training course provided by safety officers, have to join all activities of safety training

2. They must use PPE correctly in order to protect themselves from any accidents by chance.

3. They must pay more attention related to process of works, operation of machine, and be careful in safety areas of work by looking at safety promotion such as safety signs, safety boards, and other communication pictures.

4. When the accidents happen, workers have to know how to report injuries, type of accidents at workplace to supervisors.

5. No alcohol at work for all employees; workers are prohibited from using alcohol while working to avoid accidents.

5.6 Conclusions

From the whole of this chapter, summaries can be described as the following: the results of this research have been divided into 4 parts as current status of SM, factors influencing SM, cause-effect diagram and in-depth interviews with 4 experts. The current status of SM in local company: 61% of interviewees as project managers claimed that they have conducted PPE in their company while other 11 components is less than 50% were carried out by local contractors. However, international contractors conducted 12 elements of SM in their company and after surveying, only 3 elements as job hazard analysis, health assurance program, hazard control program were not carried out by them. And other 9 elements are higher than 50% conducted by international contractors. So we can conclude that the current status of SM of local contractor is worse than international contractors and it need a lot improvement for local company. The international contractors have better performance on status of SM than local but it still need to improve more. 9 affecting factors have been identified. In order to improve safety management performance at construction sites, the cause-effect diagram has been set up to find the cause and the problems of influencing factors and the in-depth interview are also carried out by face to face interview with 4 respondents (recommendations).

CHAPTER VI
CONCLUSIONS

6.1 General

This research has discussed the finding of current status of SM, and factors affecting safety management and also provides contractors' viewpoint for improving safety management in the Cambodian construction sites. The objectives of study, data collections, and analyses will be described shortly as conclusion. This chapter will summarize the findings in previous chapters, limitations of study and the further study.

6.2 Conclusions

Construction is one of the most dangerous industries in which to work due to the complexity and its unique nature. Construction safety management is the key to measure the implementation of safety management on job site. Moreover, nowadays construction safety management in Cambodia is very poor and there are no safety regulations or standards in the Cambodian construction companies. Many problems appear remarkable in the whole Cambodian construction projects such as accidents, injuries, no safety resources, workers deaths, and no accident reports or investigations. All of these problems can be due to the absence of safety standards, and knowledge about application of safety management in Cambodia. To solve these problems, construction project managers should have studied and been aware of application of safety management by exploring current status of safety management and factors affecting safety management in construction sites.

The main purposes of this study are to measure the current status of safety management in construction and identify important factors influencing construction safety management, and propose the recommendation for improving safety management performance in construction sites in Cambodia from contractors' viewpoint.

This research only focuses on building construction projects and Contractor Companies, which were chosen to get the necessary information. The questionnaire surveys; interview and on-site-observation techniques were designed for gathering the necessary information and data in the Cambodian construction sites. Two places in

Cambodia were chosen to conduct the surveys, namely Phnom Penh capital city, and Siem Reap province. For current status of SM and Factors influencing, both local and international contractor companies with 30 project managers who were interviewed, 24 project managers are local contractors (medium company) and 6 are international project managers (large company). Meanwhile, 24 local construction sites and 6 international construction sites were observed respectively. 20 Project managers were interviewed to explore causes and problems of influencing factors, and 4 experts in contractors firms were also selected to interview for suggestion improvement of SM.

6.2.1 Current status of safety management in both local and international contractor companies in Cambodia

From results, the current status of safety management has been evaluated of the 12 elements that were carried out by local project manager, there is only personal protection equipment conducted by local contractor that is more than 50%, while other 11 elements lower than 50% are safety policy, safety organization, safety training, safety program for inspection hazardous, safety committee, site accident/incident investigation, job hazard analysis, safety promotion, health assurance program, hazard control program, emergency preparedness.

Those results show respectively, 61% of interviewees' project managers said that they have provided enough personal protection safety equipment to employees, but less than 50% of workers used PPE during working process (site observation); 44% of local contractors claimed that they have set up and do stress safety on job site; 25% of local company revealed that they have a safety organization in their companies; 33% of safety training has been conducted by local contractors; only 99% of safety program for inspection hazardous were not used by local companies; 23% of respondents claimed that they have no external committee but just have internal by having small meeting in every morning before starting work at sites; 46% of project managers claimed that they conducted accident investigation at workplace; 92% of respondents said that their companies don't really conduct job hazard analysis; 49% of interviewees as project managers claimed that they have conducted safety promotion on site such as 100% safety sign, bulletin board is 63%, 4%accident statistics, and 29% publish a bulletin; 97% of local contractors have no health

assurance program; 92% of project managers claimed that they have no hazardous control program; and 46% of interviewees said that their companies have an emergency preparedness.

In contrast, the current status of SM by international contractors is following: only three elements as job hazard analysis, health assurance program, and hazard control program were not conducted by international contractors while others nine components were carried out more than 50% by international project managers. 88% of international contractors claimed that they have set up and do stress safety on job site; 78% of international companies revealed that they have a safety organization in their companies; 67% of safety training has been conducted by international contractors; only 50% of safety program for inspection hazardous were not used by international companies; 67% of respondents claimed that they have no external committee but just have internal by having small meeting in every morning before starting work at site; 100% of interviewees' project managers said that they have provided enough personal protection safety equipment to employees and only 57% of workers used PPE during working process (site observation); 75% of project managers claimed that they conducted accident investigation at workplace; 100% of respondents said that their companies do not really conduct job hazard analysis; 63% of interviewees as project managers claimed that they have conducted safety promotion on site such as 100% safety sign, bulletin board is 83%, 17% accident statistics, and 50% publish a bulletin; 100% of international contractors have no health assurance program; 100% of project managers claimed that they have no hazardous control program; and 75% of interviewees said that their companies have an emergency preparedness.

6.2.2 Factors influencing safety management in Cambodia

From the results in both local and international contractors companies, nine major factors affecting safety management in construction sites in Cambodia have been identified namely, cost or budget, safety policy, awareness of project manager/ safety managers, safety training, safety organization, safety regulation, personal protection equipment, site accident/incident investigation, and safety committee. In order to improve safety management, the cause-effect diagram has been used in order to get information about the cause of those factors affecting and the problems of those

factors as see in chapter 5, (Figure 5.6). *Cost or budget, lack of safety cost* due to fail to finance by customers, lack of involvement of government, and lack of safety regulation to force contractor to include safety cost in bidding. *Safety policy: inadequate setting of safety policy* due to awareness of firms' top management being poor and not enough resources to implement. *Safety training: lack of safety training* as poor knowledge of project managers, no training school, lack of resource for safety training. *Safety organization: shortage of set up safety organization structure,* due to having no package of safety cost, and insufficient knowledge of project managers. *Personal protection equipment*: lack of PPE provide by contractor or lack of attention to personal safety protection by workers. *Safety regulation: lack of set up safety regulation by main contractors* due to top management of contractors' lack of knowledge of safety management. *Awareness of project managers/ safety manager: poor awareness of project managers or safety manager* due to low knowledge on safety management in construction sites, lack of attention of project manager of main contractors to safety management. *Safety committee: lack of safety committee* because companies have no budgets to set up committee, safety training course, and safety has not received much attention by contractors, owners, and consultants.

6.2.3 Recommendations for improving safety management in Cambodia from contractors' viewpoint

According to the research findings of currents status of safety management, factors influencing, results about cause, problems of factors affecting as shown in cause-effect diagram, and in-depth interview with three project managers, one safety manager who has more experience, a way to improve safety management performance has been proposed as guidelines for the Cambodian construction companies. Government has to set up safety regulation, safety books, training school, provide as certificate contractors, and require safety cost in bidding. Contractors have to provide enough PPE, training for new employees, and control process of worker during work procedure. Owners and consultants have to have minimum requirement of safety policy submitted by contractors, give priority on safety, control procedure of contractor works, and evaluate the contractors on safety performance. Engineering, safety officers and workers, have to attend training courses, and do work at site following the safety policy of company.

In conclusions, the currents status of safety management by local construction sites in Cambodia is needs a lot of improvements. Meanwhile, the currents status of safety management by international contractors is better performance than local contractors, but it still needs to improve more in order to fulfill the lack of performance, nowadays. All parties as government, owners& consultants, contractors, they all have to join together to make a better implementation of SM in Cambodia. The training program or school, for education people to improve safety management performance should be provided by government and also contractor firms. Safety costs have to be considered for parties as owners and contractors and enough PPE have to be provided by contractors. Safety policy has to be well set up by owners and contractors and all engineers and employees have to attend the training courses. Related to this, the government must play a vital role in construction projects and the involvement of local governments is inevitable.

6.3 Limitations of study

Time for data collection is the major constraint of this research. The period of this research was not long enough for data collection from interviewing of respondents of company as project managers. For time of interviewing, most interviewees provided inadequate time to interview as it was not like estimate of interviewing time, and they do not have time available for us in this research. Also, some projects managers had nearly completed their projects, when interviewing was conducted with them. So, it can impact data collection gathering from their perceptions. Other more important constraint is that most project managers in Cambodia have no knowledge on safety management, and they rarely consider safety on job site.

6.4 Further study

The further study should be conducted as the following recommendation:

This research should study more details in the whole Cambodia in order to find more factors affecting and provide a better recommendation for improving safety management and the data collection should be gathered from not only contractors but also owners as well as consultants.

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APPENDICES

APPENDIX A

QUESTIONNIARE FOR THE FIRST DATA COLLECTION

(Evaluate the current status and identify factors affecting safety management in construction sites in Cambodia)

CHULALONGKORN UNIVERSITY

FACULTY OF CIVIL ENGINEERING

QUESTIONNAIRE SURVEY

''A STUDY OF SATUS OF SAFETY MANAGEMENT AND FACTORS INFLUENCING SAFETY MANAGEMENT IN CONSTRUCTION SITES in CAMBODIA ''

Prepared by: Bunhav LIM
(Master of Construction Engineering and Management)

Name of Company : .....
Name of Respondent: .....
Position : .....
Date : .....

Part A: General Information

Please tick (√) one of the choices shown below:

1. What kinds of your ***organization function***?

   □ Contractor □ Owner
   □ Government Agency □ Consultant
   □ Others ……

2. What type of your company in Cambodia?

   □ International Company :
      □ Large
      □ medium
      □ small
   □ Local Company :
      □ large
      □ medium
      □ small

3. Which of the following ***Age Categories*** for yourself?

   □ 20 – 25 years old □ 36 – 40 years old
   □ 26 – 30 years old □ 41 – 45 years old
   □ 31 – 35 years old □ > 45 years old

4. How long have *you* work for Construction Company as project manager?
   - Experience: …….. Years …….. Months

5. How many projects have you done till now, since your experience as project manager?
   - Number of Projects: ……. .Projects

Part B: Identify status of safety management & Factors influencing safety management in the Cambodian construction site

I. Criteria to measure status of safety management

Areas of safety elements management system for measuring status needed to explore:

1. Safety policy
2. Safety organization
3. Safety training
4. Safety program for inspection hazardous
5. Safety committee
6. Personal protection equipment
7. Site accidents/ incident investigation
8. Job hazard analysis
9. Safety promotion
10. Health assurance program
11. Hazard control program
12. Emergency preparedness

1. Please tick under the word YES/NO or tick as the following question:
   1. What certification does your company have?

☐ ISO 9001

☐ ISO 14001

☐ OSHAS 18001 Others ……

Note: Part observation; put the number of worker using the personal protection equipment under the column Yes/No into the table below.

Part of observation

Items	Evidence	Used	Not used
Personal protection equipment	Head protection equipment (helmet)		
	Face protection equipment (face shields, welding mask)		
	Eyes protection equipment (glasses, goggles)		
	Body protection equipment (long-sleeved jacket, wear safety harness with double lanyards for scaffold and riggers and single lanyard)		
	Hand protection equipment (gloves)		
	Ear protection equipment (ear plugs, ear muff)		
	Respiration protection equipment (dust mask, respirator)		
	Foot protection equipment (safety shoes)		

Part of interview:

1. Safety policy:

a. Does the policy clearly state that decision on other priorities should give due regard to health and safety requirement?
   Yes No ……..Evidence

b. Does the policy commit the organization to full compliance with all relevant health and safety legislation?
   Yes No ……..Evidence

c. Does the company have safety procedure and manual at construction sites?
   Yes No ……..Evidence
   If yes, please provide me the detail of it.

d. Is the policy explained to the new employees as part of their training and orientation prior to the commencement of work?
   Yes No

2. Safety organization:

a. Is there an organization chart showing the name and positions with responsibility lines for safety performance management?
   Yes No ……..Evidence

b. Have the individual health and safety responsibilities of all employees been clearly defined?
   Yes No

c. Is someone in charge of updating health and safety information, including changes to regulation, new codes of practices, newly identified hazards, and new work practice?
   Yes No ……..Evidence

3. Safety training:

a. Is there a health and safety training plan and is it reviewed regularly?
   Yes No ……..Evident

b. Have all employees received basic or site-specific safety training before starting the work at site?
   Yes No ……..Evidence
   If Yes, it is the regular training:
   Daily:……..per month
   Weekly:……..per month
   Monthly:……..per year

4. Safety program for inspection hazardous:

a. Does the company have the safety program for inspection hazardous, and is it appropriate arrangement to monitor the effectiveness and thoroughness of the inspection?
   Yes No ……..Evidence
   If yes, please give me the inspection hazardous checklist. (If possible)

b. Do safety officer and safety supervisors carry out safety inspections at regular intervals?
   Yes No ……..Evidence

c. Are there appropriate arrangements to collate and analyze the result of safety inspections?
   Yes No ……..Evidence

5. Safety committee:

a. Is there any safety committee set up to identify, or recommend and keep under review measures to improve the safety and health and work place?
   Yes No ……..Evidence

b. Is there any safety meeting in your construction sites?
   Yes No ……..Evidence
   If yes, it is the regular meeting:

5. **Personal protection equipment:**
   a. Does the work at construction sites require the use of PPE?
      Yes □ No ……..Evidence
   b. Is there a procedure to monitor the PPE brought on site by workers?
      Yes □ No ……..Evidence
   c. Are there procedures to ensure the proper use of PPE as well as training and instruction in the construction sites?
      Yes □ No ……..Evidence
   d. What is the most common PPE is provide to workers?
      Helmet □ Face shields/full face welding mask □ Glasses
      Goggles □ Long sleeved jacket, □ Wear safety harness
      Gloves □ Ear plugs □ Ear muffs
      □ Dust mask □ Respirators □ Safety shoes
6. **Site accidents/ incident investigation:**
   a. Does your company conduct injury, incident investigation in this construction sites?
      Yes □ No ……..Evidence
      If yes, please provide me, a sample of investigation form.
   b. Are there any accident reports, if the accidents have occurred during the construction process?
      Yes □ No ……..Evidence
      If yes, please provide me the accident reports.
7. **Job hazard analysis:**
   a. Do your construction sites conduct job safety analysis?
      Yes □ No
      If yes, please give me the step of job safety analysis or work sheet analysis.
8. **Safety promotion:**
   a. Are safety bulletin boards provided and located so that all employees can see during the working day?
      Yes □ No ……..Evidence
   b. Are accident statistics distributed or displayed?
      Yes □ No ……..Evidence
   c. Are safety signs and posters prominently displayed?
      Yes □ No ……..Evidence
   d. Does the organization publish a bulletin that includes material related to occupational health and safety?
      Yes □ No ……..Evidence
9. **Health assurance program:**
   a. Does your company have a program to protect workers from health hazards during working day for your construction sites?
      Yes □ No ……..Evidence
10. **Hazard control program:**
   a. Do your construction sites have the procedure of the hazard accident control program?
      Yes □ No ……..Evidence
      If yes, please show me the hazard report form about it.
11. **Emergency preparedness:**
   a. Is there the emergency procedure existing at jobsite while working such as Emergency Siren or alarm system?
      Yes □ No ……..Evidence
   b. Does a company publish or post the list of emergency contacts (police station number, hospital telephone…) or sign (emergency exit) at construction sites?
      □Yes □ No ……..Evidence

II. Factors influencing safety management in the Cambodia construction sites

Pleas tick in the box below (all can be possible answers)

1. Which of the following factors is more likely affecting the construction sites safety management in Cambodia?

□ a. Safety policy □ i. Safety organization

□ b. Safety training □ j. Emergency preparedness

□ c. Safety committee □ k. Personal protection equipment

□ d. Job hazard analysis □l. site accidents/incident investigation

□ e. Health assurance program □ m. Hazard control program

□ f. Poor awareness of project manager □ n. Safety promotion

□ g. Safety program for inspection hazardous

□ h. Safety regulation □ o. cost or budget

□ All factors above

□ Except: …….

2. Beside the all factors above, what is more specific factors influencing the Cambodia construction sites safety management?

Answers: ……

……

……

……..……

……

……

APPENDIX B

QUESTIONNIARE FOR THE SECOND DATA COLLECTION

(Cause and Effect Diagram in order to suggest improvement safety management in the Cambodian construction sites)

CHULALONGKORN UNIVERSITY

FACULTY OF CIVIL ENGINEERING

QUESTIONNAIRE SURVEY

''A STUDY OF STATUS OF SAFETY MANAGEMENT AND FACTORS INFLUENCING CONSTRUCTION SITES SAFETY MANAGEMENT IN CAMBODIA ''

Prepared by: Bunhav LIM

(Master of Construction Engineering and Management)

(Pilot Study)

Name of Company : .....

Name of Respondent: .....

Position : .....

Date : .....

Part A: General Information

Please tick (√) one of the choices shown below:

1. What kinds is your ***organization function***?
   - ☐ Contractor
   - ☐ Owner
   - ☐ Government Agency
   - ☐ Consultant
   - ☐ Others ……
2. What type is your company in Cambodia?
   - ☐ International Company :
     - ☐ Large
     - ☐ medium
     - ☐ small
   - ☐ Local Company :
     - ☐ large
     - ☐ medium
     - ☐ small
3. Which of the following ***Age Categories*** is for yourself?
   - ☐ 20 – 25 years old
   - ☐ 26 – 30 years old
   - ☐ 31 – 35 years old
   - ☐ 36 – 40 years old
   - ☐ 41 – 45 years old
   - ☐ > 45 years old
4. How long have *you* worked for Construction Company as project manager?
   - Experience: …….. Years …….. Months
5. How many projects have you done till now, since your experience as project manager?
   - Number of Projects: ……..…….. Projects

Part A: Measurement for improvement of construction site safety management in Cambodia

- Here are the main 9 factors affecting safety management (system) in the Cambodia construction sites that were explored :

No	Factors affecting safety management in Cambodia construction sites
1	Cost or Budget
2	Safety policy
3	Safety training
4	Safety organization
5	Personal Protective Equipment
6	Safety regulation
7	Awareness of Project manager/Safety manager
8	Site accident/incident investigation
9	Safety committee

- Meaning of each factors above :

- **Cost / budget:** refer to the resources (cost/budget) that we use to set up the safety management system and implement of each elements of safety management well or not well in order to lead the project succeed, safety and health at work place. (managers can create an organizational setting in which *workers will be trained and motivated to perform safe and productive construction work*)
- **Safety policy:** refers to the general intentions, approach and objectives of an organization together with the criteria and principle on which action and responses are based.*(clear direction for organization to follow, procedure to the work base on requirement of safety standard, regulation to achieve safety performance, safety at work place*)
- **Safety training:** training to equip personnel with knowledge to work safely without risk to health at work place; that workers understand *the basics or site specific training of skill of work procedures* that need to require the training's needs. And training helps people acquire the skill, knowledge and attitude to make them competent in the safety aspects of their work.
- **Safety organization:** a structure to assure implementation of the commitment to safety at work (*Organization chart showing the name, position with responsibility* line for safety performance management).
- **Personal protective equipment (PPE):** the construction sites require use of PPE such as Helmet, Glasses, safety shoes, Gloves, Dust mask, Ear Plug, Ear Muff, Goggles, Long sleeved jacket, Wear safety harness, safety belt.
- **Safety regulation:** safety standard, regulation or policy of the company, regulation set up by the government.
- **Awareness of Project manager/safety manager:** refer to the knowledge or skill of the project manager to manage or implementing of safety management in construction sites succeed or not succeed (safety work procedure at work place).
- **Site accident/ incident investigation:** to find out the cause of any accident or incident and to develop prompt arrangements to prevent recurrence (Accident reports, conduct injury/accident investigation at construction sites).
- **Safety committee:** safety committee to identify, recommend, and keep under review measures to improve the safety and health at work (*safety meeting, monitor the safety policy, evaluation the implement of safety management*).

✓ Based on your opinion, according to the 9 main factors influencing site safety management in Cambodia,

✓ Please provide me problems cause of those factors effecting by answering the following question :

A. Cost / budget: ☐ Shortage, ☐ Enough, ☐ other…….

- Why does *cost/ budget* affecting safety management in construction sites?
  ……
  ……
- How do the affecting factors *Cost/budget* influencing safety management in construction sites? (what are the Problems)
  ……
  ……

B. Safety policy ☐Inadequate of setting ☐other ……

- Why *Safety policy* affecting safety management in construction sites?
  ……
  ……
- How the affecting factors *Safety policy* influencing safety management in construction sites? (what are the Problems)
  ……
  ……

C. Safety training ☐Insufficient ☐Other……

- Why does *Safety training* affecting safety management in construction sites?
  ……
  ……
- How do the affecting factors *Safety training* influencing safety management in construction sites? (what are the Problems)

……

D. Safety organization ☐Shortage of set up the structure, ☐ Other……

- Why does *Safety organization* affecting safety management in construction sites?
  ……
- How do the affecting factors *Safety organization* influencing safety management in construction sites? (what are the Problems)
  ……
  ……

E. Personal protective equipment ☐Lack of PPE, ☐ Other……

- Why does *personal protective equipment* affecting safety management in construction sites?
  ……
  ……
- How do the affecting factors *personal protective equipment* influencing safety management in construction sites? (what are the Problems)
  ……

F. Safety Regulation No regulation, Inadequate, Other……

- Why does *Safety regulation* affecting safety management in construction sites?
  ……
- How do the affecting factors *Safety regulation* influencing safety management in construction sites? (what are the Problems)
  ……
  ……

G. Awareness of project manager/safety manager Poor, other……

- Why does *Awareness of project manager/safety manager* affecting safety management in construction sites?
  ……
- How do the affecting factors *Awareness of project manager/safety manager* influencing safety management in construction sites? (what are the Problems)
  ……

H. Site accident/ incident investigation

- Why does *site accident/incident investigation* affecting safety management in construction sites?
  ……
- How do the affecting factors *site accident/incident investigation* influencing safety management in construction sites? (what are the Problems)
  ……

I. Safety committee shortage of monitoring by; other……

- Why does *safety committee* affecting safety management in construction sites?
  ……
- How do the affecting factors *safety committee* influencing safety management in construction sites? (what are Problems)
  ……

CHULALONGKORN UNIVERSITY

FACULTY OF CIVIL ENGINEERING

QUESTIONNAIRE SURVEY

''A STUDY OF STATUS OF SAFETY MANAGEMENT AND FACTORS INFLUENCING CONSTRUCTION SITES SAFETY MANAGEMENT IN CAMBODIA ''

Prepared by: Bunhav LIM
(Master of Construction Engineering and Management)
(Full Study)

Name of Company : .....

Name of Respondent: .....

Position : .....

Date : .....

Part A: General Information

Please tick (√) one of the choices shown below:

1. What kinds is your ***organization function***?
   - ☐ Contractor
   - ☐ Owner
   - ☐ Government Agency
   - ☐ Consultant
   - ☐ Others ……
2. What type is your company in Cambodia?
   - ☐ International Company :
     - ☐ Large
     - ☐ medium
     - ☐ small
   - ☐ Local Company :
     - ☐ large
     - ☐ medium
     - ☐ small
3. Which of the following ***Age Categories*** is for yourself?
   - ☐ 20 – 25 years old
   - ☐ 26 – 30 years old
   - ☐ 31 – 35 years old
   - ☐ 36 – 40 years old
   - ☐ 41 – 45 years old
   - ☐ > 45 years old
4. How long have *you* worked for Construction Company as project manager?
   - Experience: …….. Years …….. Months
5. How many projects have you done till now, since your experience as project manager?
   - Number of Projects: ……..…….. Projects

Part A: Measurement for improvement of construction site safety management in Cambodia

- Here are the main 9 factors affecting safety management (system) in the Cambodia construction sites that were explored :

No	Factors affecting safety management in Cambodia construction sites
1	Cost or Budget
2	Safety policy
3	Safety training
4	Safety organization
5	Personal Protective Equipment
6	Safety regulation
7	Awareness of Project manager/Safety manager
8	Site accident/incident investigation
9	Safety committee

- Meaning of each factors above :

- **Cost / budget:** refer to the resources (cost/budget) that we use to set up the safety management system and implement of each elements of safety management well or not well in order to lead the project succeed, safety and health at work place. (managers can create an organizational setting in which *workers will be trained and motivated to perform safe and productive construction work*)
- **Safety policy:** refers to the general intentions, approach and objectives of an organization together with the criteria and principle on which action and responses are based.*(clear direction for organization to follow, procedure to the work base on requirement of safety standard, regulation to achieve safety performance, safety at work place*)
- **Safety training:** training to equip personnel with knowledge to work safely without risk to health at work place; that workers understand *the basics or site specific training of skill of work procedures* that need to require the training's needs. And training helps people acquire the skill, knowledge and attitude to make them competent in the safety aspects of their work.
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- **Safety committee:** safety committee to identify, recommend, and keep under review measures to improve the safety and health at work (*safety meeting, monitor the safety policy, evaluation the implement of safety management*).

✓ Based on your opinion, according to the 9 main factors influencing site safety management in Cambodia,

✓ Please provide me problems cause of those factors effecting by answering the following question :

A. Cost / budget

- Why does *cost/ budget* affecting safety management in construction sites?

  Shortage of contractors' budget, Lack of budget (minimize cost in bidding)

  Due to the client failing to finance the project (most of the customers need the lower price in bidding), some projects don't put amount of money for bidding on safety in construction sites (reduce cost).

  Because government doesn't put in enough effort to monitor construction projects on safety management during bidding (lack of involvement of local government, government projects).

  No safety policy to push all construction contractors to put a package of safety cost in bidding on safety management following some standards such as ISO or OSHA before bidding and starting the projects.

  Most of the projects in Cambodia, local owner and main contractors not awareness of site safety (not include cost for safety management).

- How do the affecting factors *Cost/budget* influencing safety management in construction sites? (what are the Problems)

  Contractors can not buy or support materials and arrange the safety team or safety organization

  Can not set up the safety management well (exclude some elements of safety management)

  Lead to accident in construction sites

  Poor safety conscientiousness of workers (no incentive)

  Low resources for safety on site/ shortage of safety facilities

  No safety inspections

  Others: ……

B. <u>Safety policy</u>

- Why does Safety policy affecting safety management in construction sites?

  Inadequate setting of safety policy

  Due to shortage of resources for implementing safety policy

  Due to poor safety awareness of firms' top management

- How do the affecting factors *Safety policy* influencing safety management in construction sites? (what are the Problems)

  Hard to control or arrange all safety teams

  Many accidents can take placed in construction sites

  Not enough implementation by safety organization

  Procedure of working will be missed the minimum requirement of safety standard

  No safety inspection,

  Other……

C. <u>Safety training</u>

- Why does *Safety training* affecting safety management in construction sites?

  Insufficient safety training

  Poor safety knowledge of projects safety managers, safety officer

  Due to no detail of safety training plan

  No resources for safety training

  Other……

- How do the affecting factors *Safety training* influencing safety management in construction sites? (what are the Problems **)**

  Accidents in construction sites when they don't know how to use equipment correctly.
  Fail to operation of machines and equipment properly or lack of understanding of job procedure.
  Hard to manage in work place safely.
  Project start is not smooth or can be late (leads to not succeed in implementing of SM
  Lack of skilled workers.(lack of providing safety training to employees)
  Other……

D. Safety Organization

- Why does *Safety organization* affecting safety management in construction sites?

  Shortage of set up the organization structure
    Due to having no package of safety cost to set up safety organization chart
    Due to lack of knowledge of safety management by project/safety managers
    Other……

- How do the affecting factors *Safety organization* influencing safety management in construction sites? (what are the Problems)

  Difficult to control safety team in construction sites
  Hard to manage work safely in site (site engineering responsible for all part of safety)
  Lack of implementation of safety policy
  No safety teams to monitor weather the worker fails to use or not use their safety tool
  No safety engineers to keep up to date with recommendation new code of practice and all information applicable to workers
  Other……

E. <u>Personal protective equipment</u>

- Why does *personal protective equipment* affecting safety management in construction sites?

  Lack of PPE or lack of attention to personal safety protection by worker
    Due to the low cost/having no package of safety cost, (company provide not enough PPE to worker)
    Lack of appropriate safety training program
    Low level education of workers
    No proper check or control of using PPE during working process
    Other……

- How do the affecting factors *personal protective equipment* influencing safety management in construction sites? (what are the Problems)

  Many cases of accident can occur (e.g. Falling from height, head damage and so on)
  Stop working at site for a while in case of incidents occuring by chance
  PPE effect on cost of material as high price

Other……

F. Safety Regulation

- Why does *Safety regulation* affecting safety management in construction sites?

  In adequate safety regulation of main contractors

  Due to no safety regulation from government
  The top management on knowledge of safety management
  The most companies have no safety standard (just copy some parts of safety from various sources and implement in construction sites)
  Non strict and not focusing on site safety by owner, consultants
  Other……

- How do the affecting factors *Safety regulation* influencing safety management in construction sites? (what are the Problems)

  Lack of strict operation of works procedure
  Hard to force safety team to do work
  Accident take placed, while having no safety manual or procedure
  No clear requirement standard for some kinds of job
  Other……

G. Awareness of project manager/safety manager

- Why does *Awareness of project manager/safety manager* affecting safety management in construction sites?

  Poor awareness of project manager or safety manager by main contractor
  Low knowledge on safety management in construction sites
  Lack of attention of project manager or safety manager of main contractor
  Misunderstanding and not giving value to safety on construction projects
  Other: ……

- How do the affecting factors *Awareness of project manager/safety manager* influencing safety management in construction sites? (what are the Problems)

  Accidents easier to occur, and hard to manage or implement SM
  Lead to fail the projects safety management system
  Process of management on site safety is not good (miss of implementing of safety policy)
  Fail to carry out site inspection, liaise with the person in charge of works
  Lack of view and update safety plan based on the project process
  Not clearly defined safety policy, hard to manage and organize the safety team
  Other……

H. Site accident/ incident investigation

- Why does *site accident/incident investigation* affecting safety management in construction sites?

  Lack of site incident investigation
  Do not have the competent person to carry out accident investigation
  Lack of gathering information
  Other……

- How do the affecting factors *site accident/incident investigation* influencing safety management in construction sites? (what are the Problems)

The accident can re-occur (no investigation)
Lost or damage properties
Can not find the source/causes of accidents
Other……

I. Safety committee

- Why *safety committee* affecting safety management in construction sites?
  No /lack safety committee
  Due to no budget for safety committee
  Due to no safety coursed training (nobody know or care about safety)
  Due to safety having not received much attention from contractors, owners and consultants
  Other …….
- How do the affecting factors *safety committee* influencing safety management in construction sites? (what are Problems)
  No evaluation, no committee to check implementation of safety management performance
  No safety committee will lead to not monitoring of process of safety workplace at site
  Without valuating from safety committee, safety managers or project managers can do what they want to do at site on safety, they are concerned only with their profits and they are not strict on site safety
  Lack of monitoring safety policy leads to determine whether it is adequate and how it well it is being implemented.
  Other……

APPENDIX C

Data analysis of current status of safety management
(Site Observation)

Part of Observation: Local Company

Table C1 Example of raw data from Observation with 24 construction sites & results of each construction site as percentage

		total	125	workers		total	60	workers		total	175	workers		total	250	workers	
		Site 1				Site 2				Site 3				Site 4			
Items	**Evident**	**Yes**	**No**	**Percentage**		**Yes**	**No**	**Percentage**		**Yes**	**No**	**Percentage**		**Yes**	**No**	**Percentage**	
Site Observation				**Yes**	**No**			**Yes**	**No**			**Yes**	**No**			**Yes**	**No**
Personal protection equipment	Head protection equipment (helmet)	105	20	84%	16%	0	60	0%	100 %	100	75	57%	43%	250	0	100 %	0%
	Face protection equipment (face shields, face welding masks)	4	8	33%	67%	0	12	0%	100 %	2	8	20%	80%	35	0	100 %	0%
	Eyes protection equipment (glasses, goggles)	0	12	0%	100 %	0	6	0%	100 %	1	8	11%	89%	15	0	100 %	0%
	Body protection equipment (long-sleeved jacket,	0	7	0%	100 %	0	5	0%	100 %	0	9	0%	100 %	5	0	100 %	0%
	Hand protection equipment (gloves)	65	60	52%	48%	6	54	10%	90%	140	35	80%	20%	250	0	100 %	0%
	Ear protection equipment (ear plugs)	0	15	0%	100 %	0	8	0%	100 %	5	15	25%	75%	45	0	100 %	0%
	Respiration protection equipment (dust mask, respirator)	15	110	12%	88%	4	56	7%	93%	55	120	31%	69%	250	0	100 %	0%
	Foot protection equipment (safety shoes)	113	12	90%	10%	2	58	3%	97%	145	30	83%	17%	250	0	100 %	0%
	Safety Belt (falling from height)	0	9	0%	100 %	2	8	20%	80%	8	0	100 %	0%	10	0	100 %	0%

Note :

Numbers below the column Yes/No are the amount of worker who used personal protective equipment.

Site refer to construction had been observed

total: ….. is the total of workers who worked during site observation; example: total 125 = 125 workers

Part of Observation: International Contractor Companies (large company)

Table C2 Example of raw data from observation with 6 construction sites & results as percentage (international contractors)

		total	105			total	85		
		Site 1				Site 2			
Items	**Evident**	**Yes**	**No**	**Percentage**		**Yes**	**No**	**Percentage**	
Site Observation				**Yes**	**No**			**Yes**	**No**
Personal protection equipment	Head protection equipment (helmet)	100	5	95%	5%	75	10	88%	12%
	Face protection equipment (face shields face welding masks)	10	2	83%	17%	0	2	0%	100%
	Eyes protection equipment (glasses, goggles)	3	1	75%	25%	6	0	100%	0%
	Body protection equipment (long-sleeved jacket,	0	4	0%	100%	0	8	0%	100%
	Hand protection equipment (gloves)	90	15	86%	14%	70	15	82%	18%
	Ear protection equipment (ear plugs)	0	13	0%	100%	0	5	0%	100%
	Respiration protection equipment (dust mask, respirator)	45	60	43%	57%	0	85	0%	100%
	Foot protection equipment (safety shoes)	105	0	100%	0%	80	5	94%	6%
	Safety Belt (falling from height)	6	2	75%	25%	10	1	91%	9%

Table C3 Result of current status of worker using PPE (local contractors)

Average of worker used PPE (Total site) based on percentage each construction sites			
Items	**Evident**	**Percentage of worker using PPE**	
Site Observation (24 construction sites)		**Yes**	**No**
Personal protection equipment	Head protection equipment (helmet)	41%	59%
	Face protection equipment (face shields)	21%	79%
	Eyes protection equipment (glasses, goggles)	12%	88%
	Body protection equipment (long-sleeved jacket)	4%	96%
	Hand protection equipment (gloves)	28%	72%
	Ear protection equipment (ear plugs, ear muffs)	5%	95%
	Respiration protection equipment (dust mask, respirator)	12%	88%
	Foot protection equipment (shoes)	53%	47%
	Safety Belt (falling from height)	18%	82%

Table C4 Result of current status of worker using PPE (International contractors)

Items	**Evident**	**Percentage of worker using PPE**	
Site Observation (6 construction sites)		**Yes**	**No**
Personal protection equipment	Head protection equipment (helmet)	91%	9%
	Face protection equipment (face shields face welding masks)	50%	50%
	Eyes protection equipment (glasses, goggles)	60%	40%
	Body protection equipment (long-sleeved jacket,	17%	83%
	Hand protection equipment (gloves)	82%	18%
	Ear protection equipment (ear plugs)	14%	86%
	Respiration protection equipment (dust mask, respirator)	45%	55%
	Foot protection equipment (safety shoes)	97%	3%
	Safety Belt (falling from height)	61%	39%

APPENDIX D

Data analysis of current status of safety management

(Interviews technique)

Table D1 Results of status safety management with 24 project managers (local contractors)

	Total of project manager respondent	24			
	Result of status of safety management	**Local company**			
No	**Items**	**Yes**	**No**	**%Yes**	**%No**
1	**Safety Policy**				
a		15	9	63%	
b		5	19	21%	
c		12	12	50%	
d		10	14	42%	
2	**Safety organization**				
a		7	17	29%	
b		6	18	25%	
c		5	19	21%	
3	**Safety training**				
a		7	17	29%	
b		9	15	38%	
4	**Safety program for inspection hazardous**				
a		3	21	13%	
b		3	21	13%	
c		2	22	8%	
5	**Safety committee**				
a		2	22	8%	
b		9	15	38%	
6	**Personal Protective Equipment (PPE)**				
a		24	0	100%	
b		12	12	50%	
c		8	16	33%	
7	**Site accident investigation**				
a		8	16	33%	
b		14	10	58%	
8	**Job hazard analysis**				
a		2	22	8%	
9	**Safety Promotion**				
a		15	9	63%	
b		1	23	4%	
c		24	0	100%	
d		7	17	29%	
10	**Health assurance program**				
a		3	21	13%	
11	**Hazard control program**				
a		2	22	8%	
12	**Emergency procedures**				
a		4	20	17%	
b		18	6	75%	

Table D2 Results of status safety management with 6 project managers (international contractors)

Total of project manager respondents					6
	Result of status of safety management	**International Company**			
No	**Items**	**Yes**	**No**	**%Yes**	**%No**
1	**Safety Policy**				
a		6	0	100%	
b		5	1	83%	
c		6	0	100%	
d		4	2	67%	
2	**Safety organization**				
a		5	1	83%	
b		5	1	83%	
c		4	2	67%	
3	**Safety training**				
a		3	3	50%	
b		5	1	83%	
4	**Safety program for inspection hazardous**				
a		0	6	0%	
b		5	1	83%	
c		4	2	67%	
5	**Safety committee**				
a		2	4	33%	
b		6	0	100%	
6	**Personal Protective Equipment (PPE)**				
a		6	0	100%	
b		6	0	100%	
c		6	0	100%	
7	**Site accident investigation**				
a		3	3	50%	
b		6	0	100%	
8	**Job hazard analysis**	0	6		
a		0	6	0%	
9	**Safety Promotion**				
a		5	1	83%	
b		1	5	17%	
c		6	0	100%	
d		3	3	50%	
10	**Health assurance program**				
a		0	6	0%	
11	**Hazard control program**	0	6		
a		0	6	0%	
12	**Emergency procedures**				
a		3	3	50%	
b		6	0	100%	

APPENDIX E

Data analysis of factors affecting safety management
(Both local and international contractor companies)

Identify factors by interviewing with 6 project managers from international company

Table E1 Raw data of identify factors in international contractors

No	Factors affecting site safety management in Cambodia	Project manager1	PM.2	PM3	PM4	PM5	PM6
1	Safety policy		1		1	1	1
2	Safety training	1	1		1	1	1
3	Safety committee	1	1		1	1	1
4	Job hazard analysis						
5	Health assurance program		1				
6	Awareness of Project manager/Safety manager	1	1	1	1	1	1
7	Safety program for inspection hazardous						
8	Safety regulation	1	1		1	1	1
9	Safety organization		1	1	1	1	1
10	Emergency procedures						
11	Personal protection equipment		1	1	1	1	
12	Site accident/incident investigation	1			1	1	1
13	Hazard control program						
14	Safety promotion						
15	Cost/ budget	1		1	1	1	1
16	all above						

Identify factors by interviewing with 24 project managers from local company

Table E2 Raw data of identify factors in local contractors

No	Factors affecting site safety management in Cambodia	Project manager1	PM.2	PM.3	PM.4	PM.5	PM.6	PM.7	PM.8	PM.9	PM.10
1	Safety policy	1			1				1	1	
2	Safety training	1	1	1	1	1			1	1	1
3	Safety committee		1						1		1
4	Job hazard analysis										
5	health assurance program										
6	Awareness of Project manager/Safety manager			1		1				1	1
7	Safety program for inspection hazardous										
8	Safety regulation	1	1		1				1	1	
9	Safety organization	1	1		1				1	1	1
10	Emergency procedures				1						
11	Personal protection equipment	1	1		1				1	1	1
12	Site accident/incident investigation		1		1					1	1
13	Hazard control program										
14	Safety promotion				1						
15	Cost/ budget	1	1	1	1	1	1	1		1	1
16	all above										

Note: Number under the column of each project manager is the respondents answer to factors affecting safety management.

Table E3 Results of data analysis of identifying factors in both international & local contractors

No	Factors affecting site safety management in Cambodia	Local Comp.	International Comp.	Total	% local	%internal	Average
1	Safety policy	12	4	16	50%	67%	**58%**
2	Safety training	16	5	21	67%	83%	**75%**
3	Safety committee	4	5	9	17%	83%	**50%**
4	Job hazard analysis	0	0	0	0%	0%	0%
5	Health assurance program	0	1	1	0%	17%	8%
6	Awareness of Project manager/Safety manager	11	6	17	46%	100%	**73%**
7	Safety program for inspection hazardous	0	0	0	0%	0%	0%
8	Safety regulation	12	5	17	50%	83%	**67%**
9	Safety organization	13	5	18	54%	83%	**69%**
10	Emergency procedures	1	0	1	4%	0%	2%
11	Personal protection equipment	13	4	17	54%	67%	**60%**
12	Site accident/incident investigation	10	4	14	42%	67%	**54%**
13	Hazard control program	0	0	0	0%	0%	0%
14	Safety promotion	1	0	1	4%	0%	2%
15	Cost/ budget	17	5	22	71%	83%	**77%**
16	all above	6	0	6			

APPENDIX F

Data analysis and results of cause-effect diagram
(Both local and international contractor companies)

Table F2 Results of data analysis for cause-effect diagram

A. Cost or Budget *Why does cost/ Budget affect safety management in construction sites?*	***Projects managers (Number of respondents)***
Shortage of constructors' budget, Lack of budget(minimize cost in building)	20
Due to the clients failure to finance the project (most customers need the lower price in bidding), some project do not put amount of money for bidding on safety in construction (Reduce cost)	20
Because government doesn't put in enough effort to monitor construction projects on safety management during bidding (lack of involvement of local government)	18
No safety policy to push all construction companies to put amount of money in bidding on safety management following some standards such as ISO or OSHA before bidding and starting the projects.	19
Most of the construction building projects in Cambodia, local owner and main contractors not aware of site safety (not include cost for safety management)	20
How do the affecting factors Cost/budget influencing safety management in construction sites? (what are the Problems)	***Projects managers (number of respondents)***
Contractors can not buy or support materials and arrange the safety team or safety organization	20
Can not set up the safety management well (exclude some elements of safety management)	17
Low resources for safety on site or shortage of safety facilities	19
Lead to accident in construction sites	15
Poor safety conscientiousness of workers (in case of having no incentive, etc)	11
No safety inspection	14
B. Safety Policy Why does *Safety policy* affecting safety management in construction sites?	***Projects managers (Number of respondents)***
Inadequate setting of safety policy:	20
Due to shortage of resources for implementing safety policy	20
Due to poor safety awareness of firms' top management	18
How do the affecting factors *Safety policy* influencing safety management in construction sites? (what are the Problems)	***Projects managers(number of respondents)***
Hard to control or arrange all safety teams	20
Many accidents can placed in construction sites	13
Not enough implementation of safety policy by safety organization	18
Procedure of working will be missed or undefined the minimum requirement of safety standards	18
No safety inspection, accident and juries whenever the safety policy is not strict or not well prepare	16

Note: all why question of each problem items (e.g. *Cost or budget*) have only one answer as the Factor affecting (e.g. *Lack of safety cost/Budget).* Then the next answer is for the question why Lack of safety Budget for safety management in construction site?

C. Safety training *Why does Safety training affecting safety management in construction sites?*	***Projects managers (number of respondents)***
Insufficient of safety training:	20
Due to poor safety knowledge of projects safety managers, safety officers	20
Due to no detail of safety training plan	17
Due to no resources for safety training	18
How do the affecting factors Safety training influencing safety management in construction sites? (what are the Problems)	***Projects managers (number of respondents)***
Accidents in construction sites when they don't know how to use equipment correctly	18
Failure to operate of machines and equipment properly or lack of understanding of job procedure	17
Hard to manage in work place safely	13
Project start is not smooth or can be late (lead to not succeed in implementation of SM)	19
Lack of skill workers (lack of providing safety training to employees, or not enough safety induction to workers)	18
D. Safety Organization Why does *Safety organization* affecting safety management in construction sites?	***Projects managers (number of respondents)***
Shortage of set up the organization structure:	20
Due to having no package of safety cost to set up the organization chart	18
Due to the insufficient knowledge on safety management by project/safety managers	19
How do the affecting factors *Safety organization* influence safety management in construction sites? (what are the Problems)	***Projects managers (number of respondents)***
Difficult to control safety team in construction sites	14
Hard to manage work safely in site (site engineering responsible for all part of safety)	16
Lack of implementation of safety policy	16
No safety engineers to keep up to date with recommended new code of practice and all information applicable to employees	5
No safety team to monitor weather the worker fail to use or not use their safety tool (no safety inspection to check the safety performance)	19
E. Personal Protective equipment Why does *personal protective equipment* affect safety management in construction sites?	***Projects managers (number of respondents)***
Lack of PPE provided by contractor or lack of attention to personal safety protection by worker:	18
Due to the low cost or having no package of safety cost, (company provides not enough PPE to worker)	18
Lack of appropriate safety training program	8
Low level education of workers	15
No proper check or control of using PPE during working process	17

How do the affecting factors *personal protective equipment* influence safety management in construction sites? (what are the Problems)	***Projects managers (number of respondents)***
Many cases of accident can occur (e.g. Falling from height, head damage and so on)	17
Stop working at site for a while in case of incidents occurring by chance	18
PPE affecting cost of material as high price	15
F. Safety Regulation	***Projects managers (number of respondents)***
Why does *Safety regulation* affect safety management in construction sites?	
Inadequate set up of safety regulation of main contractors:	20
Due to no safety regulation from government	16
Due to the top management on knowledge of safety management	18
Most companies have no safety standard (just copy some parts of safety from various sources and implement in construction sites)	19
Non strict and not focusing on site safety by owners or consultants	13
How do the affecting factors Safety regulation influence safety management in construction sites? (what are the Problems)	***Projects managers (number of respondents)***
Lack of strict operation procedure	20
Hard to force safety team to do work	10
Accident often takes place, while having no safety procedure or manual	5
No clear requirement standard for some kinds of job	7
G. Awareness of project manager/safety manager	***Projects managers (number of respondents)***
Why does *Awareness of project manager/safety manager* affecting safety management in construction sites?	
Poor awareness of project manager or safety manager by main contractor:	20
Low knowledge on safety management in construction sites	18
Lack of attention of project manager or safety manager of main contractor	15
Misunderstanding and not giving value to safety on construction project or site	17
How do the affecting factors *Awareness of project manager/safety manager* influence safety management in construction sites? (what are the Problems)	***Projects managers (number of respondents)***
Accidents easier to reoccur, and hard to manager or implement SM	20
lead to failure of the project safety management system (lack of carry out of work task on site)	13
Process of management on site safety is not good (miss of implementation of safety policy)	15

Failure to carry out site inspection, liaise with the person in charge of works.	6
Lack of review and update safety plan based on the process of projects	13
Not clearly defined safety policy, hard to manage and organize the safety team	17
H. Site accident/ incident investigation Why does *site accident/incident investigation* affect safety management in construction sites?	***Projects managers (number of respondents)***
Lack of site incident investigation:	20
Don't have the competent person to carry out accident investigation	20
Lack of gathering information by safety officer	15
How do the affecting factors *site accident/incident investigation* influencing safety management in construction sites? (what are the Problems)	***Projects managers (number of respondents)***
The accident can re-occur (no investigation)	18
Lost or damaged properties	20
Can not find the source/causes of accidents	15
I. Safety committee Why does *safety committee* affecting safety management in construction sites?	***Projects managers (number of respondents)***
No or lack of safety committee	20
Due to no budget for safety committee	20
Due to no safety course training (nobody knows or cares about safety)	18
Due to safety having not received much more attention from contractors, owners, and consultants	20
How do the affecting factors *safety committee* influencing safety management in construction sites? (what are Problems)	***Projects managers (number of respondents)***
No evaluation, no committee to check implementation of safety management performance	20
Lack of reviewing, recommendation or editing by safety committee	20
Without evaluating or monitoring from safety committee, safety managers or project managers can do what they want to do at site on safety, they are concerned only with their profits and they are not strict on site safety	18
lack of monitoring safety policy leads to determine whether it is adequate and how well it is being implemented	19

APPENDIX G

In-depth interview for improving safety management
(Structured interview)

Structured Interview (face to face)

Name: …… Position: …….

Company: …….. Address: ……..

- According to the research findings, the current status of safety management was evaluated and 9 major factors affecting safety management in the Cambodia construction sites were explored. (As seen in Appendix C Table C3,4; Appendix E Table E3; and Figure 5-6 Cause-Effect Diagram)

What are the recommendations that should be proposed by parties such as Government, contractors, owners & consultants, safety engineer, and employees as workers?

(Example of structures interview as Safety Cost)

Government:

Lack of safety cost: (Add safety cost in bidding)

- Before bidding, contractors are required to put amount of package of safety cost by owner, forced by government
- Others ……

Owners

- Give priority to safety in construction by considering safety cost in bidding and require all contract to consider safety cost in tendering
- Others ……

Contractors

- Included package of safety cost in bidding in order to set up safety plan well
- Others ……...

- In your opinion, please kindly provide suggestions for improving safety management performance at site that should be adopted by the Cambodia Construction Company. What are the improvements that should be introduced to improve the current level of safety management in Cambodia?
- Respondents:

……

……

……

Note: during interview the results of current status, factors effecting safety management, and cause-effect diagram were showed to them (project managers, safety manager). (Recorded all information by recorder)

Respondent: 1

Name: ……SOK Sothyra…… Position: …Managing director……..
Company: ……..PISNOKA INTERNATIONAL CORP……..
Address: No 51 st 322 Beng keng kang1 chamkar mon, phnompenh, Cambodia

- **Government:**

- Create safety standards, safety department (contractors, owners, consultants have to obey, external pressure from government), Cambodia has no safety standard or Safety books or safety rules, to force contractors to give priority to safety
- Before starting new projects, contractors have to contact first, and need submit documents such as area location, building permitted. etc.
- Before bidding, contractors need to have safety plus cost
- Provide safety information regarding the proposal job, work task activity and safety representative to ensure site safety(site visit)
- Government should describes contract specification as guidelines to control all risks of participations such as asking name, submit hazard plan, safety standard that contractors will base
- Set up school for training safety courses to all level engineer, provide certificate
- Provide certificate to contractor which performs of work on well in safety in construction sites, or Stop Company which does not have safety procedures or start construction project without respect to safety standards, or policy
- Force owner have to set up safety committee to evaluate work process of contractor, and report to government.

- **Contractors**

- Before carrying out the activities, contractors need to submit project safety management plan to the client
- Need to consider the package of safety cost in bidding
- PPE have to be provided enough to workers
- All new employees need to be provided safety training before starting job (by project managers, safety officer)
- In order to succeed in implementation of SM, safety policy, and organization have to be well defined by top managers of contractor
- Give rewards to workers (by safety promotion)
- Need to have safety inspection, hire engineer to check at site on safety procedure, material, etc.
- Have to conduct a small meeting around 15mn-30mn to remind workers on site safety, accident take place by chance, and pay more attention
- Warning workers who do job without fallowing safety policy or regulation (in case 3 time warning, worker must be sacked)
- Conduct site accident investigation to prevent from re-occurring

- **Owners and consultants**

- Give priority to safety management by considering safety cost in bidding
- Before bidding, the minimum requirement of safety policy submitted by contractors, must satisfy by owner
- Hire consultant to evaluate the contractors safety performance base on past safety record, safety documents, and plant equipment

Respondent: 2

Name: ……SOK Sothy…… Position: …Safety Manager…..……..
Company: ……..PISNOKA INTERNATIONAL CORP……..
Address: No 51 st 322 Beng keng kang1 chamkar mon, phnompenh, Cambodia

- **Government:**

- Increase all kinds of lack of each influencing factor
- Create safety standards, safety department (contractors, owners, consultants have to obey, external pressure from government)
  - Safety books or safety rules, to force contractors to give priority to safety
- Before bidding, contractors need to have safety plus cost.
- Provide safety information regarding the proposal job, work task activity and safety representative to ensure at site safety(site visit)
- Need to have safety inspection, hire engineer to check at site on safety procedure, material, etc.
- Provide as certificate to contractor which conduct well in safety in construction sites, or Stop Company which not do allow as safety procedures or start construction project without respect to safety standards, or policy.
- Set up school for training safety courses to all levels of engineers, provide certificate

- **Contractors**

- Need to consider the package of safety cost in bidding
- All new employee need to provide safety training before starting job
- PPE has to be provided enough to workers
- Conduct site accident investigation to prevent from re-occur
- Conduct a small meeting from 15mn-30mn before starting works (to remind worker to pay more attention, review work procedures, and areas where incidents can occur by chance
- Give awards to employees who work well on safety

- **Owners and consultants**

- Give priority to safety management by considering safety cost in bidding
- Before bidding, the minimum requirement of safety policy submitted by contractors, must satisfy by owner
- Hire consultant to evaluate the contractors safety performance based on past safety record
- Help to provide instruction & orientation on site safety
- Submit safety plan as information during tendering
- Stress on job site safety before starting works tasks
- The consultants have to provide pressure to contractors by cutting some budget or stop contractor from doing job task in case that contractor works without following safety policy, or makes a big mistake related to accidents as death, injuries.

- **Engineers, safety officer, or top managers**

- Engineers have to attend safety training courses provided by , contractors, government
- They have to transfer these safety training courses to employees
- They have to ensure that all works processes at site are based on the safety policy of company
- Make sure that all levels of staff received enough and appropriate training
- Carry out site inspection, accident investigation, determine the causes of any serious accident occurrences and recommend corrective or preventive action

- **Workers**

- Need to attend training courses
- Have to know how to protect themselves by using PPE

Respondent: 3

Name: ……REN Sina…… Position: …Project Manager……..
Company: ……..Yianko Associates……..
Address: 4th floor, No 60, Preah Monivong Blvd, Sangkat Wat Phnom, Khan Daun Penh, Phnom Penh, Cambodia.

Government:

- Increase all kinds of lack of each influencing factor
- Create safety regulation or standard (contractors, owners, consultants have to obey, external pressure from government)
  - Safety books or safety rules, to force contractors to give priority to safety
- Before bidding, contractors need to have safety plus cost.
- Need to have safety inspection, hire engineer to check at site on safety procedure, material, etc.
- Provide certificate to contractor which performs well in safety in construction sites, or stop company which doesn't have safety procedures
- Set up school for training safety courses to all levels of engineers, provide certificate

Contractors

- Include safety cost in bidding
- Have a clear safety policy, where regulations will be followed
- All new employees need to be provided safety training before starting job (by safety officer, mangers)
- PPE has to be provided enough to workers
- Conduct site accident investigation to prevent from re-occur
- Conduct a small meeting every morning before starting projects

Owners and consultants

- Give priority to safety management by considering safety cost in bidding
- Before bidding, the minimum requirement of safety policy submitted by contractors, must satisfy by owner
- Hire consultant to evaluate the contractors safety performance based on past safety record
- The consultants have to provide pressure to contractors by cutting some budget or stop contractor from doing job task in case that contractor works without following safety policy, or makes a big mistake related to accidents as death, injuries.

Engineers, safety officer, or top managers

- Engineers have to attend safety training courses provided by government
- They have to transfer these safety training courses to employees
- They have to ensure that all works processes at site are based on the safety policy of company
- Make sure that all levels of staffs received enough and appropriate training
- Carry out site inspection, accident investigation, determine the causes of any serious accident occurrences and recommend corrective or preventive action

Workers

- Have to know how to protect themselves by using PPE
- Have to know area or zone where accident often takes place by looking at the safety promotion
- Report any injuries, accident at work to supervisors
- Participate in tool box meeting and other safety activities and training courses

Respondent: 4

Name: ……SAMRETH Mardi…… Position: …Project Manager…..……..
Company: ……..Mega Asset Management Co., Ltd……..
Address: No 265-269, Ang Duong Street, Phnom Penh, Cambodia.

Government:

- Increase all kinds of lack of each influencing factor
- Create safety law, (contractors, owners, consultants have to obey, external pressure from government)
  - Safety books or safety rules, to force contractors to give priority to safety
- Before bidding, contractors need to have safety plus cost.
- Need to have safety inspection, hire engineer to check at site on safety procedure, material, etc.
- Provide certificate to contractor which performs well in safety in construction sites, or stop company which does not have safety procedures or start construction project without respect to safety standards, or policy.
- Set up school for training safety courses to all levels of engineers, provide certificate

Contractors

- Need to consider the package of safety cost in bidding
- All new employees need to be provided safety training before starting job
- PPE has to be provided enough to workers
- Conduct site accident investigation to prevent from re-occur

Owners and consultants

- Give priority to safety management by considering safety cost in bidding
- Before bidding, the minimum requirement of safety policy must satisfy by owner
- Hire consultant to evaluate the contractors safety performance based on past safety record
- The consultants have to provide pressure on contractors by cutting some budget or stop contractor from doing job task in case that contractor works without following safety policy, or makes a big mistake related to accidents as death, injuries.

Engineers, safety officer, or top managers

- Engineers have to attend safety training courses provide by government
- They have to transfer these safety training courses to employees
- They have to ensure that all work processes at site are based on the safety policy of company
- Make sure that all levels of staffs received enough and appropriate training
- Carry out site inspection, accident investigation, determine the causes of any serious accident occurrences and recommend corrective or preventive action

Workers

- Have to know how to protect themselves by using PPE
- Have to know area or zone where the accident often takes place by looking at the safety promotion
- Report any injuries, accident at work to supervisors

APPENDIX H

Evidence

(Some evidence during data collection)

Safety Promotion

Emergency preparedness

Safety training

Safety regulation/rule

PISNOKA

New Employee Information

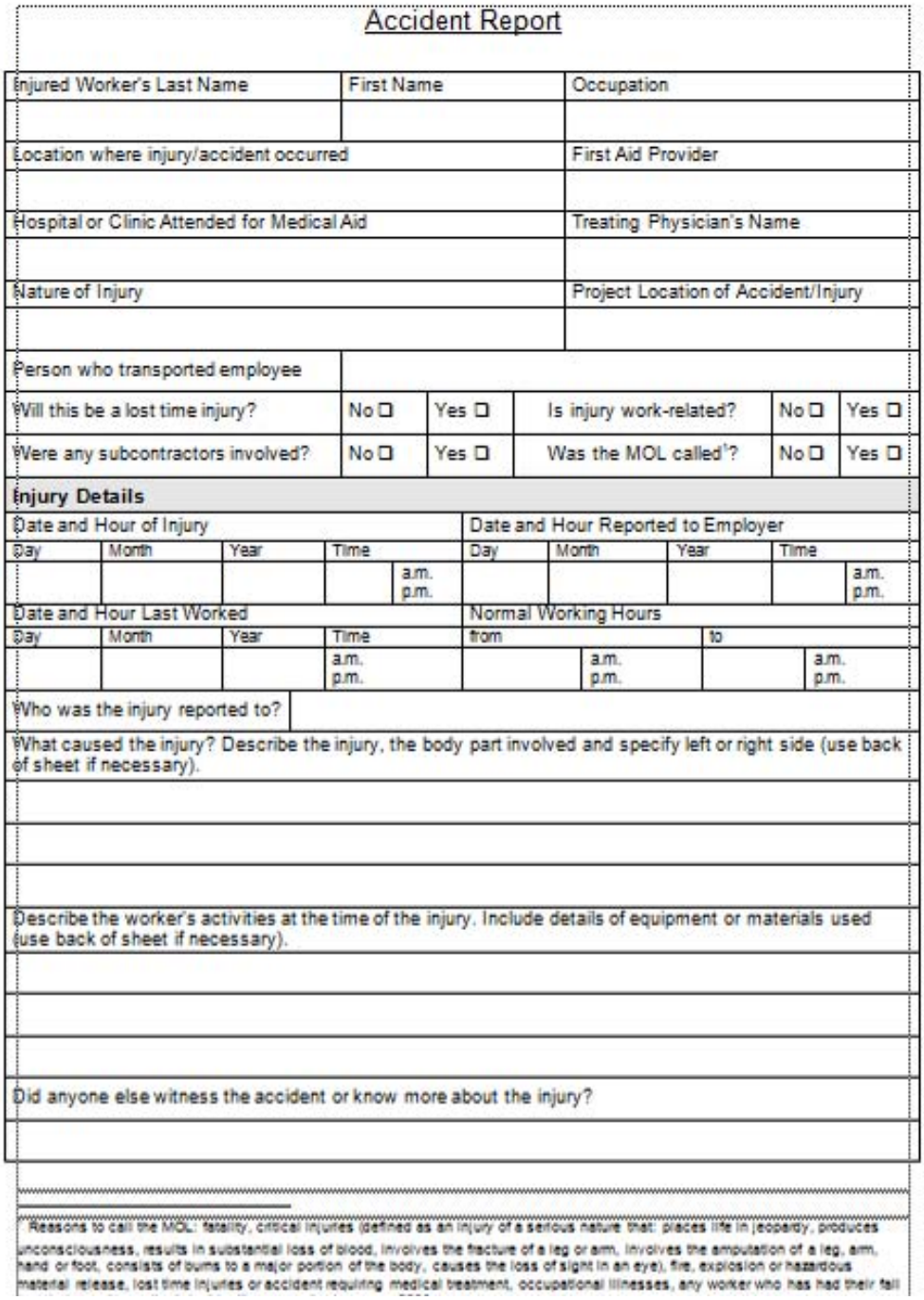
- Posted Safety Rules
  - Company **safety rules** are posted on the safety information board & general locations around site
  - Every employee is required to comply with the company safety rules and procedures. Any act which places any person in danger is strictly prohibited.
  - New arrivals must report to security guard post and sign in. ID badge must be carried at all times while on site. Security officers have authority to search body and hand bags anytime & anywhere on site.
  - All employees must obey instructions issued by the project management team, supervisors, security officers and safety officers.
  - All employees must complete a safety induction course prior to commencing work.

New Employee Information

- Safety Rules Continued
  - PPE (personal protective equipment) - All employees must wear a hard hat, safety boots, safety glasses, high visibility safety vest or high visibility shirt on the construction site at all times.
  - Correct PPE such as ear protection, safety glasses, gloves, goggles must be worn to suit construction work activities being undertaken.
  - Alcohol is strictly forbidden and is not to be consumed on site or immediately prior to starting work (no alcohol 8 hours before work). No illegal drug usage is allowed on site.
  - No prescription drugs is allowed on site unless authorized by a licensed medical doctor. Prescription drug use may have safety considerations for employee activities. Please report prescriptions medications to your supervisor if medication may cause drowsiness, dizziness or other safety concerns.

Accident reports form/Safety reports

PISNOKA accident report form



Accident Report

Injured Worker's Last Name	First Name	Occupation
Location where injury/accident occurred		First Aid Provider
Hospital or Clinic Attended for Medical Aid		Treating Physician's Name
Nature of Injury		Project Location of Accident/Injury

Person who transported employee						
Will this be a lost time injury?	No ☐	Yes ☐	Is injury work-related?		No ☐	Yes ☐
Were any subcontractors involved?	No ☐	Yes ☐	Was the MOL called*?		No ☐	Yes ☐

Injury Details

Date and Hour of Injury					Date and Hour Reported to Employer				
Day	Month	Year	Time		Day	Month	Year	Time	
				a.m. p.m.					a.m. p.m.

Date and Hour Last Worked				Normal Working Hours			
Day	Month	Year	Time	from		to	
			a.m. p.m.		a.m. p.m.		a.m. p.m.

Who was the injury reported to?	

What caused the injury? Describe the injury, the body part involved and specify left or right side (use back of sheet if necessary).

Describe the worker's activities at the time of the injury. Include details of equipment or materials used (use back of sheet if necessary).

Did anyone else witness the accident or know more about the injury?

Reasons to call the MOL: fatality, critical injuries (defined as an injury of a serious nature that: places life in jeopardy, produces unconsciousness, results in substantial loss of blood, involves the fracture of a leg or arm, involves the amputation of a leg, arm, hand or foot, consists of burns to a major portion of the body, causes the loss of sight in an eye), fire, explosion or hazardous material release, lost time injuries or accident requiring medical treatment, occupational illnesses, any worker who has had their fall

Small group meeting at site

Personal protection equipment

SITE OBSERVATION ACTIVITIES OF WORKER USING PPE

BIOGRAPHY

Bunhav LIM was born on January 03, 1987 in Siem Reap Province, Cambodia. He went to study at 10 Makara 1979 High School and finished his high school in 2004. After high school, he went to Phnom Penh City in the same year in order to continue his Bachelor degree. From 2004-2009, he conducted his study in Department of Civil Engineering at Institute of Technology of Cambodia (ITC). As soon as he graduated from ITC in a major of Civil Engineering, he was awarded AUN/SEED-Net scholarship to pursue his master's degree program in the field of Construction Engineering and Management, Chulalongkorn University, Thailand.