MANAGING CONSTRUCTION SAFETY IN CHINESE INTERNATIONAL CONTRACTORS' OVERSEAS PROJECTS: A CASE IN VIETNAM

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CERTIFICATE OF ORIGINALITY

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ABSTRACT

Chinese international contractors (CICs) play an increasingly important role in the international construction market. Safety management is important for construction companies and projects because of the risky nature of construction. Therefore, conducting a study on construction safety management in CICs' overseas projects is necessary. Safety climate is a hot topic of safety management in recent years. Despite the large number of safety climate studies in the construction industry and the persistent research interest for international construction, there has been rare safety climate study in international construction, let alone in CICs' overseas projects. Participants from various countries and regions are involved in international construction projects, for both management staff and frontline workers. Therefore, construction projects in international contexts may have even more complicated situation than those in domestic contexts.

The present research focuses on safety climate research in CICs' overseas projects. Its objectives are to 1) investigate the problems of construction safety management and difficulties of implementing safety practices in CICs' overseas projects; 2) determine the safety climate structure in CICs' overseas projects; 3) investigate the relationship between safety climate and safety performance in CICs' overseas projects; 4) identify the factors affecting safety climate in CICs' overseas projects; and 5) recommend strategies for improving construction safety in CICs' overseas projects. An exploratory sequential mixed methods research design is utilized in this study. A series of research methods containing both qualitative techniques (i.e., document analysis and structured interview) and quantitative techniques (i.e.,

Delphi survey and questionnaire survey) are used throughout the research process to fulfill the set objectives.

This study has revealed 16 problems of managing construction safety and 16 difficulties of implementing safety practices in CICs' overseas projects from a qualitative perspective. The Delphi survey findings indicate that the three most important safety management problems are: weak safety awareness of local workers, low safety management ability of local subcontractors, and inadequate safety budget; and the three most important difficulties of implementing safety practices are: labor-only subcontracting and complex labor structure, difficulty in enhancing safety awareness of local workers, and high turnover rates of frontline workers. The safety climate factors in CICs' overseas projects include: top management commitment (TMC), supervisors' expectation (SE), coworkers' caring and communication (CCC), and coworkers' role models (CRM). After verifying these four identified safety climate factors in an integrated model by structural equation modeling, TMC is tested to be positively related to SE as well as CCC and CRM significantly. SE can partially mediate the relationship between TMC and CCC and CRM, as well as that between TMC and safety performance. CCC and CRM play a statistically significant partial mediation role in the relationship between TMC and safety performance, and that between SE and safety performance. The hierarchical logistic regression analysis results indicate that nationality, religious belief, and employment mode can partially affect safety climate factors. Strategies for improving construction safety in CICs' overseas projects are recommended based on the practical implications of research findings. The most important strategies include: raise workers' safety awareness, provide safety training and education actively, ensure safety budget, manage subcontractors' safety in-depth and comprehensively, and pay attention to design, technology and equipment safety.

This study has several contributions. First, this study contributes to bridge the gaps arising from limited studies regarding construction safety in international construction projects. Second, taking CICs in Vietnam as a case, this study derives safety climate factors and explore the underlying mechanisms of the relationship between safety climate factors and safety performance in CICs' overseas projects. Third, the findings identify the crucial factors affecting safety climate in CICs' overseas projects, which in turn enable practitioners to create a positive safety culture to enhance safety performance in international construction projects.

LIST OF PUBLICATIONS

Journal Papers (Published)

<u>Gao, R.*,</u> Chan, A. P. C., Utama, W. P., and Zahoor, H. (2016). Workers' perceptions of safety climate in international construction projects: effects of nationality, religious belief, and employment mode. *Journal of Construction Engineering and Management* (IF=1.152, 5-Yr IF=1.731), 04016117.

<u>Gao, R.*,</u> Chan, A. P. C., Utama, W. P., and Zahoor, H. (2016). Multilevel safety climate and safety performance in the construction industry: development and validation of a top-down mechanism. *International Journal of Environmental Research and Public Health* (IF=2.035, 5-Yr IF=2.471), *13*(11), 1100.

Journal Papers (Under Review)

<u>Gao, R.*,</u> Chan, A. P. C., Lyu, S., Zahoor, H., and Utama, W. P. Investigating the difficulties of implementing safety practices in international construction projects from the perspective of Chinese international contractors, submitted to Safety Science.

<u>Gao, R.*,</u> Chan, A. P. C., Lyu, S., Zahoor, H., and Utama, W. P. Strategies for improving safety management in international construction projects, submitted to Journal of Professional Issues in Engineering Education and Practice.

Conference Papers (Published)

<u>Gao, R.*,</u> Chan, A. P. C., Utama, W. P., and Zahoor, H. (2015). Review and adopt a tool for measuring safety climate in international construction projects. *The*

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CHAPTER 1 INTRODUCTION

1.1 INTRODUCTION

This chapter introduces the research background, describes the problem statement, indicates the research aim and objectives, clarifies the significance and value of the current study, and delineates the research methodology and structure of the thesis.

1.2 RESEARCH BACKGROUND

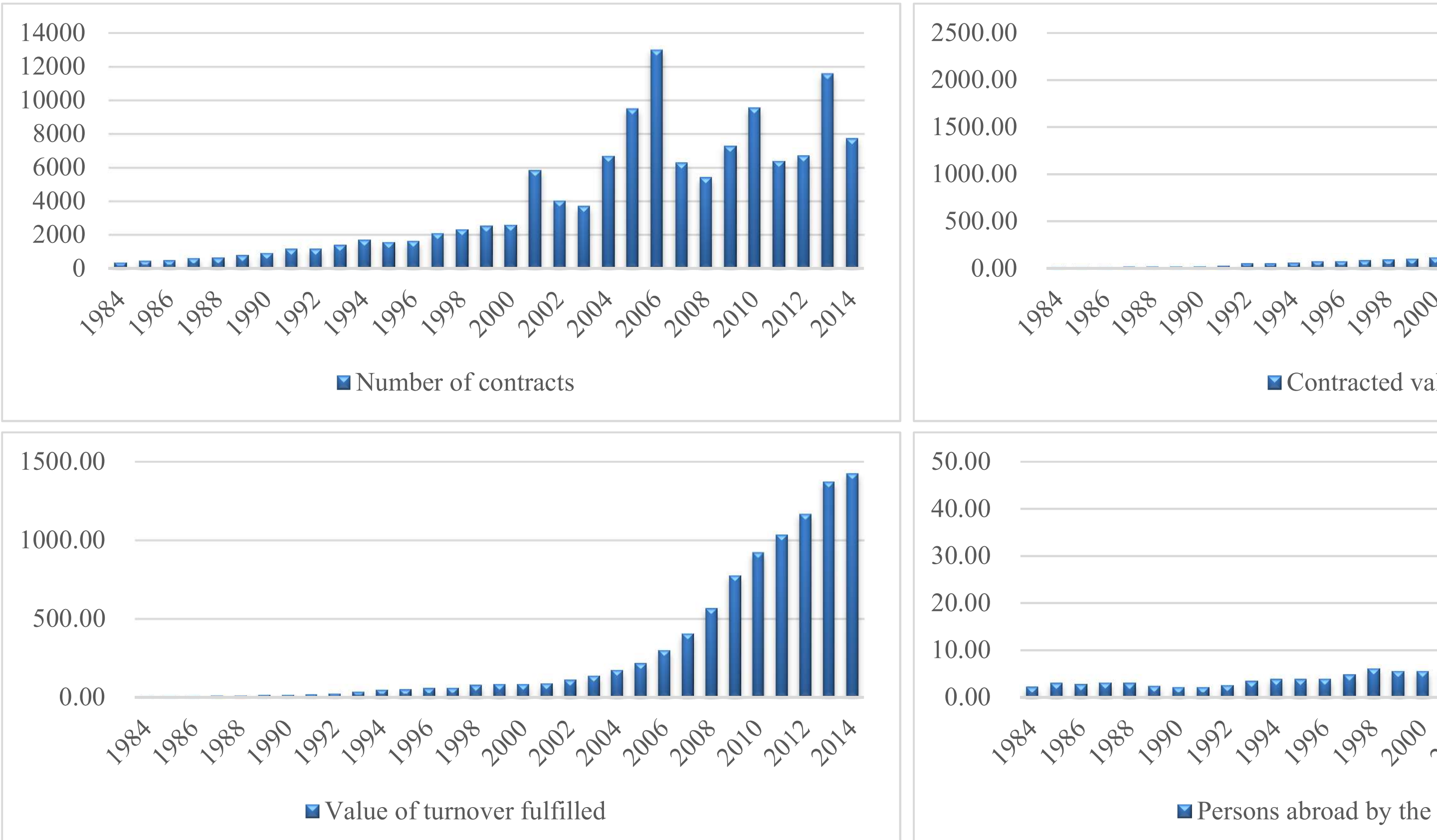
The international construction market booms with the development of advanced technology, efficient transportation, and convenient communication (Ye et al., 2009). An increasing number of construction companies have entered in the international construction market to secure more opportunities to guarantee survival and seek continuous development (Al-Sibaie et al., 2014; Ye et al., 2009). Chinese contractors are no exception. They are encouraged further by the Chinese government's "going out" strategy to compete in overseas markets. Governmental support has significantly promoted the development of Chinese contractors in the international construction market (Zhao and Shen, 2008). An upward trend of contracted projects in foreign countries or regions by Chinese international contractors (CICs) is shown in Figure 1.1. All the number of contracts, contracted value, value of turnover fulfilled, and persons abroad by the end of year for these contracted projects increased rapidly from 1984 to 2014. The statistics from the Engineering News Record (ENR) also highlights the growing important role of CICs. Table 1.1 summarizes the numbers of CICs listed in ENR's top 225/250 international contractors and annual total contracting revenue from 2002 to 2014.

In 2014, 65 Chinese construction companies were listed in the top 250 international contractors, with a total contracting revenue of USD 89.553 billion; this figure increased by 13.3% compared to the revenue in 2013 (Reina and Tulacz, 2015). According to Figure 1.2, the value of turnover fulfilled in international projects undertaken by CICs in 2014 was 45.5% in Asia and 37.2% in Africa, forming two of their most conspicuous major international markets, which mainly consist of developing and undeveloped countries (National Bureau of Statistics, 2015).

Table 1.1 Numbers of CICs listed in ENR top 225/250 international contractors and annual total contracting revenue from 2002 to 2014

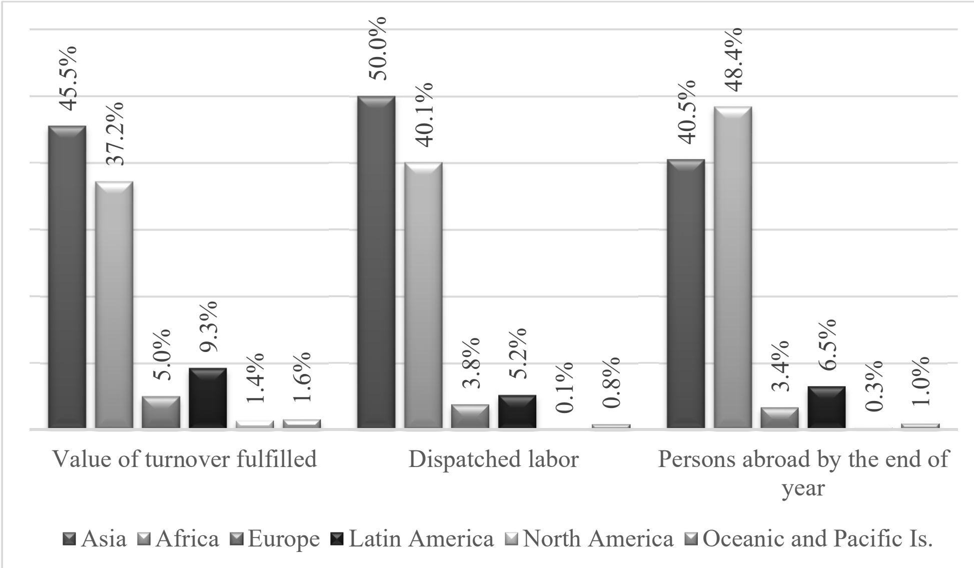
Year	Numbers of CICs listed in ENR top 225/250 international contractors	Annual total contracting revenue (USD million)
2002	43	7134
2003	47	8332
2004	49	8333
2005	46	10067
2006	49	16289
2007	51	22678
2008	50	43203
2009	54	50573
2010	51	57060
2011	52	62708
2012	55	67175
2013	62	79013
2014	65	89553

Source: Engineering News-Record, various years



Source: China Statistical Yearbook 2015

Figure 1.1 Contracted projects in foreign countries or regions by CICs from 1984 t



Source: China Statistical Yearbook 2015

Figure 1.2 Contracted projects by CICs in 2014, by continent

With the process of industrialization, safety is increasingly considered to be a priority (Mahalingam and Levitt, 2007). Safety management has emerged as an important topic in corporate management. Several previous studies have indicated that safety management has positive influences on both corporate competitiveness performance and economic performance (Fernández-Muñiz et al., 2009), whereas other studies claim that safety could only affect corporate reputation in a negative way. “Negative” in this case indicates that good safety performance could easily be ignored, whereas poor safety performance definitely results in a bad corporate reputation and leads to a competitive disadvantage (Smallman and John, 2001).

The construction industry is recognized as one of the most dangerous industries in the world (Mohamed, 2002). The complexity of the construction procedure and the temporary character of the projects expose frontline workers to dangers and accidents, and make safety a rather complex issue (Swuste et al., 2012). At a rough estimate, the construction industry occupies 30% to 40% of fatal injuries although it employs only 7% of the world's workforce (Sunindijo and Zou, 2012). A large number of studies have focused on construction safety and contributed to the improvement of safety performance (Huang and Hinze, 2006). A previous study has summarized four key topics about construction safety over the last three decades: 1) causes of construction accidents, 2) the influence of management on accident and accident prevention, 3) safety in design, and 4) safety climate and safety culture (Swuste et al., 2012).

Safety management has been considered as unsatisfactory in Chinese domestic construction projects with many inadequacies such as poor safety awareness of both top management and project managers, lack of training, reckless operations, and reluctance to input resources to safety (Tam et al., 2004). The number of occupational fatalities in construction in China increased significantly in recent years (Wu et al., 2015). Compared to domestic construction projects, international construction projects have even more complicated situation. Participants from various countries and regions are involved in international construction projects, for both management staff and frontline workers. International contractors face serious challenges when manage construction safety in global projects, especially when these projects involve participants from countries of different socioeconomic development levels (Kjellén, 2012). A case study of four international infrastructure projects reveals that law and regulation, national culture, and economic situation in project participants' countries of origin can influence the workers' perceptions of safety (Mahalingam and Levitt, 2007). Also, in international construction, the development and enforcement of safety standards varies noticeably among different countries (Raheem and Hinze, 2014). For CICs, they are facing additional numerous challenges and difficulties in their international projects because of restricted resources in many project host countries (Hu et al., 2008). As labor cost constitutes a large proportion of total cost in most construction projects, CICs continually pursue relatively economic price of labor power (Lu et al., 2009). In the past, they preferred using Chinese workers due to the abundant resource of low-wage and skilled manpower in their home countries (Lu et al., 2009; Mahalingam and Levitt, 2007). However, in recent years, because of rising cost of Chinese labor and local employment protection (Ashley and Bonner, 1987), they tend to use local labor from the project country or exploit labor supply from low-wage developing countries gradually.

Safety climate is a continuous hot research topic among construction safety studies in recent years. Safety climate is originally defined by Zohar (1980) as "a unified set of cognitions regarding the safety aspects of the organization" based on the experience of social relationships and the organizational environment, which "reflects employees' shared perceptions about the relative importance of safe conduct in their occupational behaviors (Zohar, 1980)." Several researchers regard safety climate as an outline of the underlying features of safety culture, and safety climate can forewarn safety-related problems before poor safety performance occurs (Choudhry et al., 2007a; Hon et al., 2014a). Safety climate has obtained rapid popularity as a research topic. Numerous related studies have subsequently been conducted across different industries including energy, manufacturing, and construction (Dedobbeleer and Béland, 1991; Hon et al., 2013; Hon et al., 2014b; Ma and Yuan, 2009) and in various countries (Christian et al. 2009; Zohar, 2000; Zohar and Luria, 2005). While the safety climate concept is applied in the construction industry, it is also regarded as an outstanding predictive indicator that has direct relationship to safety performance (Dedobbeleer and Béland, 1991;

Mohamed, 2002; Siu et al., 2004). Insufficient safety precautions and weak safety climate are deemed as major causes of the high industrial accident rate of the construction industry (Pinto, 2014). Meanwhile, the complicated characteristics of construction make safety climate a rather complex issue and pose challenges to safety climate research within this particular industry (Sparer et al., 2013).

1.3 PROBLEM STATEMENT

The increasingly important role of CICs in the international construction market, the significance of safety management in construction projects, and the unique characteristics of CICs' overseas projects all highlight the importance of studying construction safety management in CICs' overseas projects. However, the amount of literature available in this area is quite limited. This study focuses on safety climate in CICs' overseas projects and seeks to bridge the gaps in this area. The following fundamental research problems are to be addressed in the current study:

- What are the problems of construction safety management in CICs' overseas projects?
- Is there a significant relationship between safety climate and safety performance among CICs' overseas projects?
- What are the unique factors that could affect safety climate in CICs' overseas projects?

1.4 RESEARCH AIM AND OBJECTIVES

This study focuses on safety climate research in CICs' overseas projects. It also investigates the prevailing safety management problems and difficulties, and provides recommendations for improving the safety management levels in CICs' overseas projects. The main objectives of this study are shown in Table 1.2.

Table 1.2 Research objectives of this study

Objective	Description
Objective 1a	Investigate the problems of construction safety management in CICs' overseas projects.
Objective 1b	Investigate difficulties of implementing safety practices in CICs' overseas projects.
Objective 2	Determine the safety climate structure in CICs' overseas projects.
Objective 3	Investigate the relationship between safety climate and safety performance in CICs' overseas projects.
Objective 4	Identify the factors affecting safety climate in CICs' overseas projects.
Objective 5	Recommend strategies for improving construction safety in CICs' overseas projects.

1.5 RESEARCH METHODOLOGY

A series of research methods containing both qualitative techniques (i.e., document analysis and structured interview) and quantitative techniques (i.e., questionnaire survey and Delphi survey) were used throughout the research process to fulfill the set objectives. Qualitative content analysis, constant comparison, descriptive statistics, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), structural equation modeling (SEM), hierarchical logistic regression analysis, and statistical test were used for analyzing the empirical data. Further details can be found in Chapter 3.

For objectives 1 and 5, to get an overall picture of the CICs' safety management information, data were collected from the practitioners and projects of CICs all over the world and not limited to the cases in a particular country (the unit of analysis of 29 articles regarding specific international projects is ‘project’ while the unit for the rest 21 articles and 8 interviews is ‘practitioner’). The sample selection is representative and covers the most important markets of CICs. Further details of the sample selection can be found in Sections 3.3.2 and 3.3.3. For objectives 2 to 4, only the CICs’ projects in Vietnam were selected for data collection due to the limitation of time and fund. The reasons for taking Vietnam as an example are explained in Section 3.3.3.

1.6 PROJECT SIGNIFICANCE AND VALUE

CICs play an increasingly important role in the international construction market. Safety management is important for construction companies and projects because of the risky nature of construction. Therefore, conducting a study on construction safety management in CICs’ overseas projects is necessary. Safety climate is a hot topic of safety management in recent years. Despite the large number of safety climate studies in the construction industry and the persistent research interest for international construction, there have been no safety climate study in international construction, let alone in CICs’ overseas projects. The focus of this study is to learn safety climate structure, to examine the relationship between safety climate and safety performance, and to identify factors affecting safety climate in CICs’ overseas projects. This study also investigates safety management problems and difficulties encountered by CICs in their overseas projects and provides recommendations to enable CICs to enhance their competitiveness further by improving their safety management level. Other international contractors, especially those from developing countries, could also benefit from this study by understanding the similar situations they might meet in their own overseas projects.

1.7 STRUCTURE OF THE THESIS

Chapter 1 provides the introduction to the entire study. The chapter contains the research background, problem statement, research aim and objectives, research methodology, and project significance and value. It also outlines the structure of the thesis.

Chapter 2 reviews previous literature for providing a foundation for the research objectives. The scope of the literature review includes accident causation and reduction, international construction projects and safety management, safety climate concept and measurement, safety performance concept and measurement, relationship between safety climate and safety performance, factors affecting safety climate, and strategies for construction safety improvement.

Chapter 3 outlines the methodology of the study. The data collection methods including document analysis, structured interview, questionnaire survey and Delphi survey are described. Data analysis techniques including qualitative content analysis, constant comparison, descriptive statistics, EFA, CFA, SEM, hierarchical logistic regression analysis, and statistical test are also presented.

Chapter 4 presents an investigation of the problems of construction safety management and difficulties of implementing safety practices in CICs' overseas projects through the findings from document analysis, structured interview and Delphi survey.

Chapter 5 determines the safety climate structure using factor analysis, and examines the relationship between safety climate and safety performance using SEM in CICs' overseas projects.

Chapter 6 outlines an exploration on the factors influencing safety climate in CICs' overseas projects using hierarchical logistic regression analysis.

Chapter 7 recommends strategies for improving construction safety in CICs' overseas projects.

Chapter 8 concludes the research findings of the current study. The limitations and future research directions of this study are also presented in this chapter.

CHAPTER 2 LITERATURE REVIEW

2.1 INTRODUCTION

Literature review refers to both the finished product of the literature review which appears in a thesis or paper and the process involved in conducting a review of the literature (Ridley, 2012). Literature review provides an overview of the context where the current research is situated as well as foundation to the current research topic. This chapter reviews the literature within the current research scope in the seven following areas: 1) accident causation and reduction; 2) international construction projects and safety management; 3) safety climate concept and measurement; 4) safety performance concept and measurement; 5) relationship between safety climate and performance; 6) factors affecting safety climate; and 7) strategies for construction safety improvement.

To achieve the Objective 1a of investigating safety management problems and Objective 2b of exploring difficulties of implementing safety practices in CICs' overseas projects, literature related to safety theories and safety management in international construction projects are reviewed. Afterward, literature on safety climate concept and measurement are studied to achieve the second objective of determining the safety climate structure in CICs' overseas projects. To achieve the third objective of exploring the relationship between safety climate and safety performance in CICs' overseas projects, literature on safety performance concept and measurement as well as relationship between safety climate and safety performance are reviewed. Factors affecting safety climate are also examined to achieve the fourth objective of identifying the factors affecting safety climate in CICs' overseas projects. Finally, to achieve the fifth objective of recommending strategies for improving construction safety in CICs' overseas projects, literature on strategies for construction safety improvement are also reviewed.

A systematic and comprehensive literature search of publications is conducted through keyword search and snowball technique. Keywords in a general sense, such as "safety theory," "safety management," "construction safety," and "strategies for construction safety improvement" as well as keywords in a specific sense, such as "international construction projects," "safety climate," and "safety performance" are utilized and searched. A systematic and thorough keyword search for journal papers and conference proceedings is conducted on the electronic database of Scopus, which is the largest abstract and citation database of peer-reviewed literature, including scientific journals, books, and conference proceedings. All the identified publications are sorted by "relevance" and the abstracts of the studies are reviewed briefly. To avoid missing any important papers, they are sorted by "cited by" and double-checked. Another electronic database, namely, ISI Web of Knowledge, is searched for supplementing and cross-referencing. Books in the relevant areas are searched on The Hong Kong Polytechnic University Library Catalogue. The snowball technique is utilized to follow up references from the bibliographies of the texts and reference lists of individual papers. Keyword search is also conducted for classical construction engineering and management journals and safety journals.

2.2 ACCIDENT CAUSATION AND REDUCTION

2.2.1 Classical safety theories and accident causation

Individual and environmental hypotheses are two dominant hypotheses in classical safety theories, representing a pair of contrary elements that may affect safety, that is, nature and nurture. Individual hypothesis emphasizes the importance of human factors, whereas environmental hypothesis focuses on the external causes of accidents, such as heavy workloads, dangerous equipment, and ineffective management (Swuste et al., 2010). Most of the well-known safety theories are related to these two hypotheses, either one or both, such as accident proneness theory, domino theory, Swiss cheese model, and tripod theory. These four classical theories are reviewed and introduced briefly in this section.

Accident proneness theory is developed based on individual hypothesis, which is used to indicate that some individuals have larger possibilities of accident occurrence than others do. In this theory, accident proneness is considered a personality feature (Greenwood and Woods, 1919). Mental disorder, impulsivity during adolescence, accident experiences during adolescence, addiction, gender, race, age, and low socio-economic status are all individual factors that may contribute to accidental tendencies. Accident proneness can be either lifelong or temporary, and individuals with lifelong accident proneness tend to suffer from organic diseases (Engel, 1991).

Domino theory is related to both individual and environmental hypotheses. This theory is actually an accident causation theory emphasizing the interlinking relationship among all potential parties involved in an accident, including human factors and dangerous working environment, such as the causes of workers' unsafe acts, interaction between human and machine, role of safety management in accident prevention, cost of accidents, and even the effect of safety on productivity (Heinrich, 1941; Heinrich et al., 1980). The first domino model was developed by Heinrich (1941). In this model, a ratio of 88:10:2 was developed, indicating that 98% of accidents are preventable (i.e., 88% are the result of workers' unsafe acts and 10% can be improved through advanced technique), and the remaining 2% are regarded as "acts of God," which are inevitable. Many studies extend Heinrich's initial model by supplementing the role of safety management in accident prevention (Adams, 1976; Bird et al., 1974).

Swiss cheese model is another accident causation model developed based on both individual and environmental hypotheses. The Swiss cheese model supposes many layers of defenses before an accident occurs. Although the layers of defenses are supposed to be intact ideally, each layer has weaknesses and "holes" in the real world. Some of the "holes" are due to active failures of human, whereas the others are due to latent conditions caused by various organizational and local workplace factors, such as poor design, improper procedures, lack of training, wrong management decisions, and limited resources (Jitwasinkul and Hadikusumo, 2011). A window of opportunity for accidents is provided when latent condition "holes" are aligned through layers of defenses in a row. When a combination of active failure "holes" and latent condition "holes" penetrate all levels of defenses, an accident occurs (Reason, 2016).

Tripod theory is also developed based on individual and environmental hypotheses for accident assessment and prevention. In this theory, the basic risk factors, which are mainly “hidden” in productive and business processes, are considered to be primary causes of accidents (Hudson, 2007). This theory holds that monitoring human error can only account for 40% of reducing accidents approximately, whereas controlling basic risk factors explains the other 60%. The major basic risk factors in an accident causation chain include the following (Schubert and Dijkstra, 2009):

- Ergonomically poor workplace design;
- Poor quality of hardware (tools, equipment etc.);
- Inadequate maintenance;
- Poor housekeeping;
- Error-enforcing conditions;
- Low quality or availability of procedures;
- Insufficient training;
- Ineffective communication;
- Incompatible goals;
- Shortcomings of organization;
- Insufficient defenses.

2.2.2 Safety management and accident reduction

Safety management uses principles, framework, processes, and measures to prevent accidents and reduce injuries. Although attention to safety management is as old as civilization, the rule that a firm is responsible for producing safety products in healthy and safe means under government requirement and regulation is rather modern (Feyer and Williamson, 1998). After substantial improvements on safety management over the last hundred years, accidents and injuries continue to occur, and safety management has seemingly reached a plateau (Guo et al., 2016). Different stages of safety management are reviewed and introduced in this section. Hudson (2007) introduced a developmental line of safety management with three stages: technology, system, and culture (Figure 2.1).

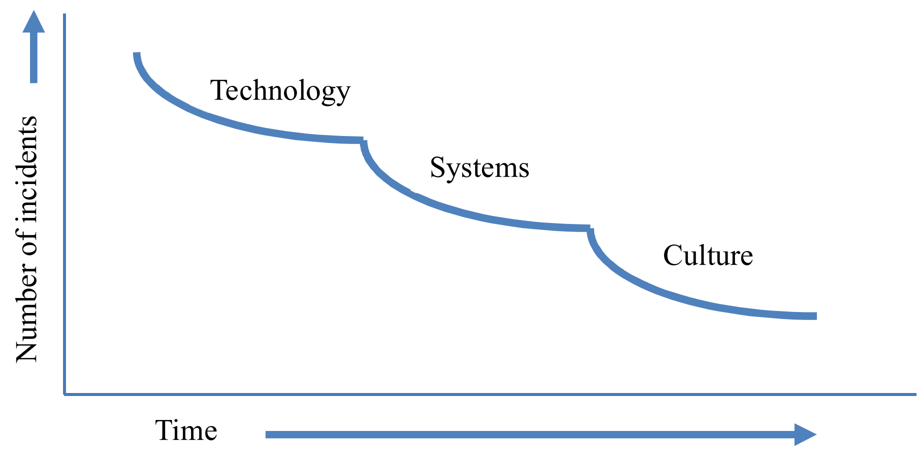
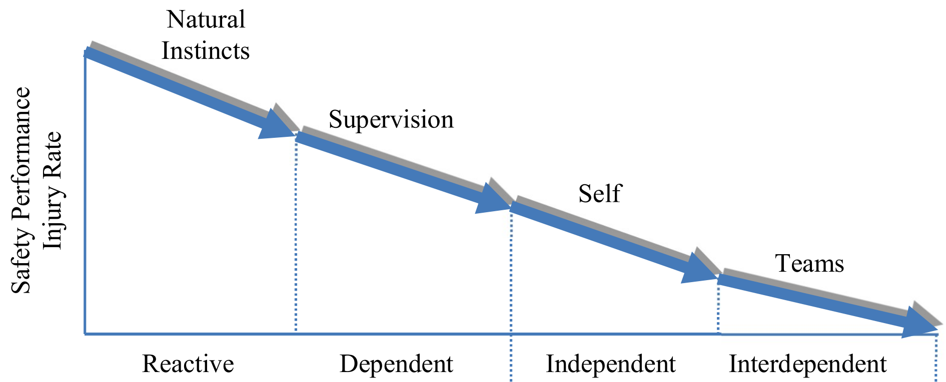


Figure 2.1 Developmental line of safety management (Hudson, 2007)

Hale and Hovden (1998) explained that technical measures to guard machinery, stop explosions, and prevent structures from collapsing could be regarded as the origin of scientific study on safety management. Later, limitations in absolute technical measures were recognized, and the focus was switched to crossfield between technology and human factors, leading to the development of probabilistic risk analysis and rise of ergonomics (Hale and Hovden, 1998). After the stage of technology, the stage of safety management systems ushered in rapid development. Although different safety management system models use different terminology, the process and workflow in different safety management systems are generally similar. According to International Labor Organization standard, the process and workflow components for safety management systems usually comprise policy, organization, planning and implementation, evaluation, and action for improvement policy (OSH, 2001). Safety management systems significantly improved safety performance since their implementation, and safety performance standards were raised accordingly. The mechanical application of safety management systems gradually reached a plateau and were insufficient to improve safety performance as desired (Hudson, 2007). On the third stage of safety management, the issue of safety culture attracted considerable interest. Under the framework of safety culture, several studies have been conducted on the issue of safety climate, which is considered as a snapshot of the features of the underlying safety culture and a concept that is easy to measure (Zohar, 1980).

As shown in Figure 2.2, the DuPont Bradley Curve introduces a process of safety culture change that leads to enhanced safety performance in organizations. This process is broken down into four phases: reactive, dependent, independent, and interdependent phases. In reactive phase, people believe that safety depends on luck rather than management, and thus they should not take responsibility themselves. In dependent phase, workers regard safety management by following safety rules and regulations made by the management, and the management supposes that safety can be managed when workers follow the rules and regulations. In independent phase, workers consider that safety is their own affair and they are responsible for themselves. They believe that safety performance can be improved with their own actions. In interdependent phase, workers from the same group take responsibility for themselves and their coworkers. They communicate actively with one another regarding safety problems and trust that safety improvement can be achieved as an entire group (Bradley, 1995).



- **Phase I: Reactive**
  Safety by natural instinct
  Compliance is the goal
  Delegated to safety manager
  Lack of management involvement

- **Phase II: Dependent**
  Management commitment
  Condition of employment
  Fear/Discipline
  Rules/Procedures
  Supervisor control and emphasis
  Value all people
  Training

- **Phase III: Independent**
  Personal knowledge and standards
  Internalization
  Personal value
  Care for self
  Practice, habits
  Individual recognition

- **Phase IV: Interdependent**
  Help others conform
  Others' keeper
  Networking contributor
  Care for others
  Organizational pride

Figure 2.2 DuPont Bradley Curve (Bradley, 1995)

Organizational factors and safety culture play an important role on accident causation and prevention. The importance of organizational factors and culture in safety management promotes the rising research interest on safety climate in recent years. Further studies on how organizational factors and safety culture, such as safety climate, can affect safety performance should be conducted in different contexts.

2.3 INTERNATIONAL CONSTRUCTION PROJECTS AND SAFETY MANAGEMENT

2.3.1 Characteristics of international construction projects

Mawhinney (2008) claimed that providing a formal definition for international construction is challenging because both words carry broad meaning. Construction covers a wide range of products, services, and activities. In this context, international is where one company headquartered in one country performs work in another country. International construction projects are projects in which the employer, main contractor, and consultant are not from the same country (Mawhinney, 2008). In many cases, international construction projects imply that most of the construction activities occur on construction sites in foreign countries in terms of the main contractor. Transnational and overseas projects are considered synonyms for international projects. To be specific, the major characteristics of the international construction projects are listed as follows:

- Risk in international construction projects is higher than that in common projects. Many factors can affect the project success during implementation.
- Parties involved in international construction projects originate from different nations. At least the employer, main contractor, or consultant is from a foreign country in terms of project location. International construction projects possess multicultural background.
- Problems related to human, such as language, communication, and cultural differences, are involved in international construction projects, and human resource management is relatively challenging.

International construction projects, which are usually large, complex, and time consuming, can be affected by economic, political, socio-cultural, and other factors. Economic factors causing difficulties in these projects mainly include inflation, foreign exchange fluctuations, and different international accounting systems (Wao and Flood, 2016). Political factors posing difficulties include expropriation, force majeure, delay in approvals, corruption, and change in law (Wang and Chou, 2003). Socio-cultural factors are related to social and cultural differences among participants in international construction projects. These factors may include risks related to labor supply, equipment availability, ethical issues, and differences in religion (Wao and Flood, 2016). Other factors that may cause problems are trade practices, including price negotiation differences and uncertainties of materials delivery (Ling and Hoi, 2006). Participants in international construction projects may be unfamiliar with the abovementioned factors, and this unfamiliarity can further complicate international construction.

International construction projects are characterized by multicultural background and problems. Many of the differences between domestic and international construction projects are attributed to social and cultural issues derived from the different traditions of people involved (Mawhinney, 2008). Cultural issues in international construction projects may cause conflicts among parties and increase the difficulties in project management (Fellows et al., 1994). Culture is “the synthesis of attitudes, values, beliefs, behaviors, work ethic, business ethics, attitude to environment, interaction with others, religion, stereotypes which have been passed on or learned” (Langford, 2000). National and corporate cultures collaborate and affect international construction projects. Corporate culture is shaped as the formation and development of large construction companies progress, and it can be affected by the national, regional, and local culture in which firms operate. Great importance should be attached to linking and understanding corporate culture in international construction companies and national culture in project locations. People with different cultural backgrounds require cross-cultural training to avoid misunderstandings that lead to interaction problems. Nevertheless, the difference between two individuals from the same nation may be larger than the assumed difference between one nation and another. Recognizing this possibility, keeping an open mind, focusing on common goals, and developing a basic understanding of other cultures are crucial in international construction projects.

2.3.2 Internationalization of Chinese contractors

Explanations of the internationalization of enterprises are heavily based on theories derived from Western multinational enterprises (MNEs). Many theories and models have been employed to explore enterprise internationalization based on MNEs, such as monopoly advantage theory (Hymer, 1960), resource-based view (Penrose, 1959), and Uppsala model (Johanson and Vahlne, 1977). Before the 1960s, foreign direct investment (FDI) was generally recognized as international capital flows to acquire high return to capital. Hymer (1960) advanced an analysis of MNEs based on industrial organization theories by showing that MNEs are institutions for international production rather than international exchange and positioning MNEs and their firm specific advantages (FSAs) at the core of his analytical approach. Hymer (1960) distinguished FDI from portfolio investment in terms of the presence of firm-level control in the former and absence in the latter. Penrose (1959) believed that growth is an endogenous process that can take the form of organic expansion, merger and acquisition, vertical integration, and diversification (both domestically and internationally). Particularly, diversification is often driven by the availability of intra-firm resources and is undertaken to profit from these resources. Uppsala model suggests that enterprises undertake international expansion in an incremental manner, indicating that internationalization involves stages, whereby the potential benefits of exploiting FSAs abroad must be weighed against the risks of operating in unknown foreign environments and costs of learning to do business there (Johanson and Vahlne, 1977).

The internationalization of Chinese contractors can also be moderately explained with the abovementioned theories. Chinese contractors have become influential competitors in terms of manpower cost advantages and continually developing technology. However, in China, the national "going global" strategy is also a remarkable driving force for enterprises to invest overseas. China's overcapacity has been well documented and often repeated in recent years. Construction enterprises that used to contract massive domestic projects from the government are now facing great difficulty (Djankov and Miner, 2016). A strong policy tint is found during the internationalization of Chinese construction enterprises (Pheng and Jiang, 2003). Pheng and Jiang (2003) claimed that the development of CICs is generally divided into three stages.

The first stage is the economic and technical aid of Chinese government. Before the 1970s, international projects of Chinese construction companies were mainly the financial aid projects that the Chinese government funded as financial donations to some developing countries. These projects were generally negotiated by the governments and managed by government authorities rather than business enterprises. As all project costs were funded by the Chinese government, these projects were not profit driven or motivated by the market. The contractors involved in these projects did not participate in the decision-making activities either. These financial aid projects did not strictly form the international construction market; rather, they provided an opportunity for CICs to undergo international expansion with personnel education and reserve and basic information about international construction market.

The second stage is the emergence of CICs. With the implementation of reform and open-up policy in China, the Chinese construction industry began to reform in the early 1980s. In international construction market, Chinese contractors gradually became independent from the government and profit driven. They started to participate in commercial bidding, tender, and negotiate for international projects. Since then, many large international construction companies were established progressively.

The third stage is the development of international contractors. Some large state-owned construction companies had acquired experience in the international market from the early 1990s. As an increasing number of companies were allowed by the Chinese government to contract overseas, the price war among Chinese contractors commenced in some countries. Contractors started to expand their businesses to new countries and regions. Until now, the Chinese international construction companies have been reforming and struggling to become strong international contractors in the global market.

Although CICs have experienced rapid development in the global market, the internationalization of Chinese enterprises has been difficult. On one hand, the steadily rising labor cost and indifferent capacity are restrictive factors for Chinese construction companies to expand the international market share (Lu et al., 2009). On the other hand, inappropriate strategies, crude organization, and working habits may result in huge losses (Ashley and Bonner, 1987). Several reports have identified the failure of overseas projects by CICs. The Mecca Light Rail, constructed by the China Railway Construction Corporation Limited (CRC) for Saudi Arabia, which costs CRC 610 million USD in losses, is a typical case in point. Pheng et al. (2004) revealed that the advantages of top British contractors were higher than those of Chinese contractors from all perspectives of ownership factors, locational factors, internalization factors, and specialty factors, although the number of Chinese contractors listed in the ENR top 225 international contractors was higher than that the British contractors (Pheng et al., 2004). Zhao and Shen (2008) analyzed the strengths, weaknesses, opportunities, and threats of Chinese contractors in international construction markets. Their strengths include cheap, skillful, and adaptable construction labor; low price of construction equipment and materials; certain advanced technologies; and good geographical location and relationship with developing countries. Their weaknesses are lack of professionals, weak design and financial competence, and language barrier. The threats comprise high commercial and political risks, increase competition in the global market, and high domestic inflation. The opportunities include governmental support, globalization of Chinese enterprises, and development of the construction industry and further open-up in the host countries (Zhao and Shen, 2008).

According to the China Statistical Yearbook 2015, CICs have been contracting projects in over 200 countries and regions. Asia and Africa are the two most conspicuous major international markets of CICs. Table 2.1 shows CICs' fulfilled turnover value of contracted projects based on continents and regions in 2014. Specifically, Southeast Asia, the Middle East, and Africa are the three regions that separately account for over 10 percent of the total value of turnovers fulfilled by CICs, and they accumulate almost two-thirds of the total value in that year. International projects in these three regions are relatively typical among all projects conducted by CICs.

Table 2.1 CICs' fulfilled turnover value of contracted projects in particular continents and regions in 2014

Continent/ Region	Value of turnover fulfilled (billion USD)	Percentage (%)
Asia	64.84	45.5%
Southeast Asia	*22.41*	*15.7%*
China - Hong Kong, Macao and Taiwan	*4.61*	*3.2%*
The Middle East (w/o Cyprus and Egypt)	*19.54*	*13.7%*
Asia other than above	*18.27*	*12.8%*
Africa	52.97	37.2%
Europe	7.15	5.0%
Latin America	13.18	9.3%
North America	2.02	1.4%
Oceanic and Pacific Is.	2.25	1.6%
Others	0.00	0.0%
Total	142.41	100.00%

Sources: China Statistical Yearbook (2015)

2.3.3 Safety management research on international construction projects

Mahalingam and Levitt (2007) conducted case studies on four comparable global railway infrastructure projects constructed by different international contractors—two from Taiwan and two from India. They observed that different safety mindsets of participants from various countries clashed in these projects, leading to project delays and cost overruns. They pointed out three major factors influencing the perception of participants on construction safety: legal rules, prevailing economic situation, and cultural values in their countries of origin. The inefficiency of safety education strategy in improving safety levels in the investigated projects indicates that international contractors should resort to forced strategies, such as the imposition of safety fines, when they attempt to transfer safety techniques on short-term international projects to undeveloped and developing countries (Mahalingam and Levitt, 2007).

Spangenbergen et al. (2003) explored the reasons for Danish construction workers having significantly higher lost-time injury rate than Swedish ones by comparing them in the construction of a combined road and rail across Øresund between Sweden and Denmark. This Øresund project could eliminate most of the usual confounded factors in comparing the safety performances of two countries because all workers in this project worked in cross-national gangs, performed the same tasks, and employed the same procedures for reporting occupational injuries. Spangenbergen et al. (2003) elaborated on the factors at the macro, meso, and micro levels. At the macro level, national waging practices during sick leaves, national educational programs, socioeconomic structure of the construction industry, and work environment legislation were key factors affecting safety performance. At the meso level, dissimilar employment practices and different planning and preparation of work were determinants of safety performance. Two factors were also proposed at the micro level, namely, training and learning and attitude toward work (Spangenberg et al., 2003).

Schubert and Dijkstra (2009) conducted an exploratory qualitative study on working safely with foreign contractors and personnel in the northern Netherlands. Ten interviews were conducted with safety professionals working in multinational enterprises in the process industry. The study identified five common challenging areas: communication, particularly communication on work permits, instructions, and risks; uncertainty about qualifications; differences in safety culture; specific employment situations; and cooperation between contractors and principals. These five problems can be placed within the conditions that have been verified in a universal context to cause accidents through certain psychological antecedents (Schubert and Dijkstra, 2009).

Kjellén (2012) evaluated two different safety management approaches used by a Norwegian international hydropower contractor in two different international construction projects located in India and the Philippines. In the Indian project, the company adopted a reactive approach to counter the poor safety performance. Based on the experiences from the Indian project, the company chose a proactive approach in the Philippine project and used contracting to guarantee sufficient conditions from the commencement of construction. Kjellén (2012) indicated that the proactive approach can present satisfactory safety outcome at reasonable costs of execution, whereas the reactive approach tends to result in poor safety outcome, which may expose companies to ethical and reputation hazards before effective remediation is proposed. Applying the proactive approach in various countries requires distinct levels of resource demands because of cultural differences (Kjellén, 2012).

The research direction focusing on the relationship between national culture and safety has also received increasing scholarly interest in recent years (Ling et al., 2013; Mearns and Yule, 2009; Mohamed et al., 2009; Reniers and Gidron, 2013; Starren et al., 2013). These studies were basically developed from Hofstede's cultural dimension theory (Hofstede, 1991; Hofstede and Bond, 1984), which established a systematic framework to assess national cultures from five cultural dimensions: large versus small power distance, individualism versus collectivism, strong versus weak uncertainty avoidance, masculinity versus femininity, and short-term versus long-term orientation. Starren et al. (2013) examined the possible effects of national culture on the major antecedents of safety behavior, such as safety knowledge, safety motivation, and safety climate. Starren et al. (2013) indicated that safety knowledge can be improved gradually with proper evidence, pictograms, and training. However, the effects of these instrumentalities can change from one person to another because of the various cultural backgrounds of the project participants who received the instruments. National cultural dimensions should only raise the sensibility of participants' different attitudes and behaviors because of the differences in cultural backgrounds rather than being adopted as the only framework to identify cultural similarities and differences among participants from various countries (Starren et al., 2013). Mearns and Yule (2009) examined the relationships among Hofstede's cultural dimensions, safety climate, and risk-taking behaviors at work through a study on six national workforce groups, including samples from the UK, the US, US Hispanic, Malaysia, the Philippines, and Australia, and they determined that only masculinity and power distance can predict risk-taking behaviors significantly. Proximal factors, such as management's commitment to safety and safety measures, exerted more influence on safety behaviors and accident rates on the jobsite than workers' national culture (Mearns and Yule, 2009). Mohamed et al. (2009) verified that collectivism, femininity, and high uncertainty avoidance can enhance workers' safety awareness and beliefs and thus lead to safer jobsite behaviors (Mohamed et al., 2009). Ling et al. (2013) echoed several research outcomes of Mohamed et al. (2009) and disclosed that operatives from countries with lower uncertainty avoidance index had poorer safety awareness than those from countries with higher uncertainty avoidance index (Ling et al., 2013). Reniers and Gidron (2013) determined whether Hofstede's cultural dimensions can predict recent fatal work injuries in nearly half of the European countries by considering the influence of national income and alcohol consumption. The results disclosed that power distance index is positively related to fatal work injuries, whereas individualism is inversely related to it, independent of alcohol consumption and national income. Uncertainty avoidance and masculinity appears insignificantly correlated with fatal work injuries. The study also implied that cultural differences among countries can forecast the risk of fatal work injuries in a global scope (Reniers and Gidron, 2013).

2.4 SAFETY CLIMATE CONCEPT AND MEASUREMENT

2.4.1 Definition of safety climate

Safety climate is "a unified set of cognitions regarding the safety aspects of the organization" based on the experience of social relationships and organizational environment, which "reflects employees' shared perceptions about the relative importance of safe conduct in their occupational behaviors" (Zohar, 1980). Safety climate is known as a subset of organizational climate; thus, the connotation of safety climate has triggered heated debate on its relationship with safety culture, similar to the discussion on the relationship between organizational climate and culture (Meliá et al., 2008). Safety culture and safety climate are different. Generally, the former mirrors the fundamental values, norms, assumptions, and expectations to risk and safety in organizations, whereas the latter describes employees' perceptions, attitudes, and beliefs on safety. Using a metaphor, safety culture is similar to "personality," whereas safety climate is similar to "mood state,"; the former is stable, whereas the latter tends to be temporary (Cox and Flin, 1998; Mearns and Flin, 1999). Safety climate is often considered a predictor of safety behavior. Several researchers regard safety climate as a snapshot of the features of the underlying safety culture, which can forewarn problems with safety that may be detected before poor safety performance occurs (Choudhry et al., 2007a; Flin et al., 2000; O'Connor et al., 2011a; Shannon and Norman, 2009). In addition to this predictive function, Zou and Sunindijo (2013) described four other functions of safety climate.

- To diagnose problems and focus energy on improving exact sections;
- To identify the developmental tendency of organizations' safety performance;

- To consume minimal resources, such as money and time;
- To involve employees by encouraging them to convey real feelings.

2.4.2 Safety climate instrument

Researchers have conducted a substantial number of studies on safety climate measurement using mainly self-explained questionnaires (Lingard et al., 2011a; Sunindijo and Zou, 2012; Zohar, 1980). As a quantitative method, questionnaire tends to be more cogent than qualitative methods in studying safety climate (Guldenmund, 2000; Mearns and Flin, 1999). Self-explained questionnaires are used to determine the perceptions of safety climate and to identify problematic areas of safety that require improvement (Choudhry et al., 2009). Some researchers have emphasized the significance of using safety climate tools accurately and precisely (Guldenmund, 2007; O'Connor et al., 2011a). Organizations would find taking proper actions to improve the safety climate impossible without reliable information (O'Connor et al., 2011b). Utilizing valid questionnaires is of utmost importance in measuring safety climate.

2.4.3 Safety climate dimensions

Among the studies on safety climate, many scholars have conducted factor analysis to identify its distinct structures and dimensions. In a milestone study, Zohar (1980) identified eight dimensions of safety climate, including perceived importance of safety training programs, perceived management attitudes toward safety, perceived effects of safe conduct on promotion, perceived level of risk at workplace, perceived effects of required work pace on safety, perceived status of safety officer, perceived effects of safe conduct on social status, and perceived status of safety committee. Since this study, many other researchers have developed their own tools to measure safety climate. Safety climate dimensions in the construction industry ranges from two (Dedobbeleer and Béland, 1991) to fifteen (Fang et al., 2006) in the existing literature. The differences in factor structures can be attributed to the different characteristics of research objectives, such as diverse cultures and industry types (Brown and Holmes, 1986; Dedobbeleer and Béland, 1991).

2.4.4 Safety climate in the current study

Meliá et al. (2008) considered safety climate from the standpoint of four safety agents, namely, organization, supervisors, coworkers, and workers. In their research, each safety climate statement was analyzed from the agents that performed or was responsible for the safety management on site. Analyzing safety climate in this way allows researchers not only to make an isolated diagnosis of safety problems related to each agent, but also to investigate the relationships among them. A safety climate model with a structure similar to that in Meliá et al. (2008) is adopted for the current research. Three safety agents including organization, supervisors, and coworkers are considered in this study. In the construction industry, top management establishes organization-wide safety policies and procedures. Management commitment to safety, which involves top management's safety attitudes and practices, is important for creating a positive safety culture (O'Dea and Flin, 2003). Prioritization of safety over production and top management attendance at safety-related activities are crucial for sound management commitment to safety (Mearns and Yule, 2009). In construction projects, most frontline workers have few opportunities to contact with top management. They are more likely to be affected by communications with members in their groups. Labors work in small groups and report to an appointed supervisor. Communication with supervisors represents to workers the real priority of safety through the practices supervisors implement company safety regulations and resolve conflicts between safety and productivity (Sparer et al., 2013). Coworkers present information, provide care, and act as role models in the work environment. Their behaviors also influence workers' task performance (Brondino et al., 2012). Coworkers are closer and larger in number than managers and supervisors. Workers tend to develop clear safety beliefs through exchanges with coworkers.

2.5 SAFETY PERFORMANCE CONCEPT AND MEASUREMENT

Safety performance is considered the key to safety on construction sites (Fang et al, 2004). Measuring safety performance can help the management in tackling safety issues by providing information, answering questions, making decisions, and addressing different information needs. After planning and implementing safety management in the organization, those concerned should measure safety performance rationally to evaluate management efficiency objectively (Ng et al., 2005). Safety performance measurement has received considerable attention in previous studies. A guide published by Health and Safety Executives (HSE) indicated that safety performance measurement should cover all elements of input, process, and outcome. Safety performance measurement should combine measures of hazard burden, health and safety management systems, failure, and health and safety culture (HSE, 2001).

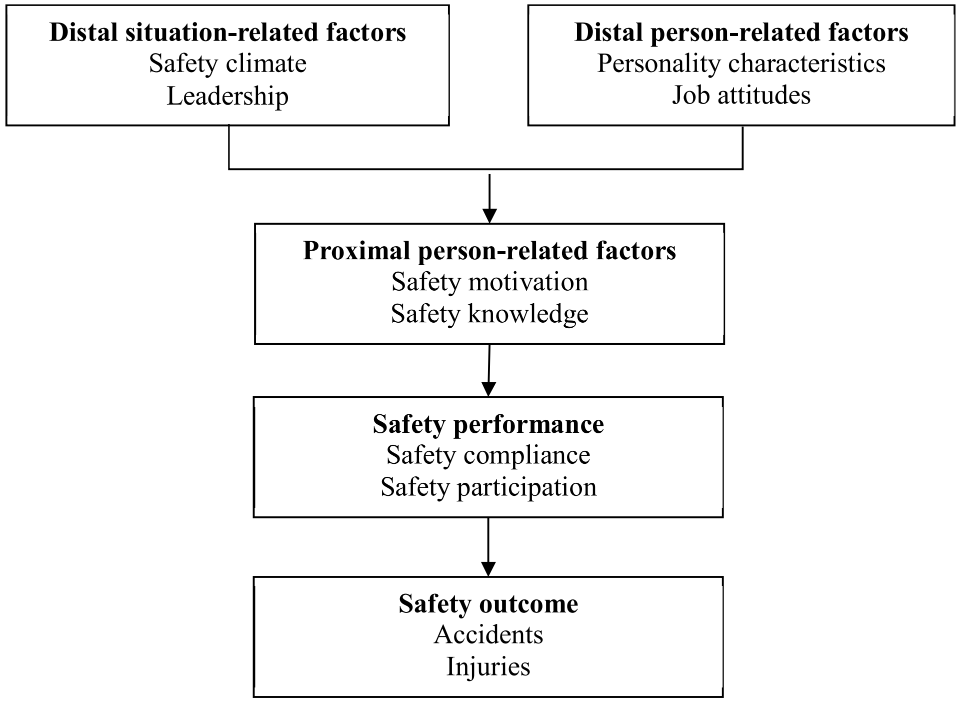


Figure 2.3 Integrative model of safety derived from Christian et al. (2009)

Chan et al. (2005) categorized safety performance measurement techniques into four major types, namely, statistics, behavioral measures, periodic safety audits, and a balanced score card approach (Chan et al., 2005). Among these measures, some are comparatively time consuming and difficult to implement in questionnaire (Choudhry et al., 2009). Given these inconveniences, only few of these measures were used in industry practices. Christian et al. (2009) conducted a meta-analysis on the safety literature including 90 studies and examined person- and situation-related antecedents of safety performance based on the theoretical models of worker performance and work climate. In the study, they classified safety performance into two categories: safety outcomes and behaviors. They also confirmed that most studies related to safety performance can fall into these two categories. According to their statistics, 92% of safety performance measures are self-reported, and 8% are archival or observer evaluation at the individual level.

At the group level, 64% of the measures are archival or rated by outside authorities and observers, whereas 31% are self-reported and aggregated to the group level, and the 5% are supervisor rated (Christian et al., 2009). Derived from their study, Figure 2.3 shows an integrative model of workplace safety to explain the relationship between the abovementioned categories.

2.5.1 Safety outcomes

Safety performance is traditionally measured by statistical data related to safety outcomes, such as accidents and injuries. Safety outcome provides historical information on bottom-line indicators of safety performance (Grabowski et al., 2007; Johnson, 2007). The four following measures are commonly used to assess past safety outcomes in the construction industry.

Accident rate (AR)

In practice, AR is often superior to other indices because it is easy to observe and compare. However, measuring performance purely by AR has been considered an unsound method because of several limitations listed as follows (HSE, 2001):

- Under-reporting;
- Accident is often a matter of chance, and thus, the absence of accidents does not necessarily mean that all hazards are under control;
- AR sometimes cannot reflect the severity of an accident but only merely its consequences;
- A low AR may result in self-complacence;
- A low AR leads to few obtainable data points;
- A failure must have existed to obtain a data point; and

- AR reflects outcomes but not causes.

Incident rate (IR)

IR can be calculated in many forms, such as lost time IR (the number of lost-time cases), severity rate, lost work day rate (number of days lost for all lost-time cases), and number of fatalities. However, similar to AR, IR can also be under-reported because of dishonest reporting of contractors. In some occasions, IR is not objective as various definitions can be adopted in the calculation process (Ng et al., 2005).

Near-miss

A near-miss is an unexpected event that has not resulted in injury or fatality despite its actual potential (Hinze et al., 2013). Toellner (2001) stated that luck is the only difference between a near-miss and an accident or incident (Hinze et al., 2013; Toellner, 2001). A near-miss is a special kind of precursor indicating an event in which no injuries or damages actually occurred but could have resulted in harm under different situations (Phimister et al., 2004). Heinrich et al. (1950) indicated that accidents on construction sites are the tip of the iceberg compared with the many near-misses found under the surface of the water (Heinrich et al., 1950). Morrison (2004) estimated that three hundred near-misses result in approximately thirty minor injuries and one major injury (Morrison, 2004).

Experience modification rating (EMR)

EMR is an index used by insurance companies to assess the cost of injuries of contractors in the past and the chances of risk in the future. Insurance premiums for workers' compensation are adjusted according to the rating. A low EMR value means a high capability of a contractor to prevent accidents through workplace safety programs. To calculate the EMR, the insurance company uses a formula that considers all work-related injuries of one contractor compared to similar contractors in the whole construction industry for the previous three years. In general, the rating is a ratio of actual losses to expected losses. The exact formula to compute EMR is presented as follows:

$$\mathrm{EMR} = \frac{\mathrm{A_p + WA_e + (1-W)E_e + B}}{\mathrm{E+B}},$$

where A_p = actual primary losses, W = weight, $\mathrm{A_e}$ = actual excess losses, $\mathrm{E_e}$ = expected excess loss, E = expected loss, and B = ballast.

2.5.2 Safety behaviors

Safety outcomes are mainly composed of historical data and cannot provide enough information to avoid future accidents effectively; a set of measures that reflect the effectiveness of safety processes to prevent accidents is necessary (Grabowski et al., 2007; Hinze et al., 2013; Mengolini and Debarberis, 2008). Burke et al. (2002) defined safety performance as the "actions or behaviors that individuals exhibit in almost all jobs to promote the health and safety of workers, clients, the public, and the environment" (Burke et al., 2002).

Safety performance is described as the actual safety behaviors that individuals performed at work and classified into safety compliance and safety participation (Neal et al., 2000). Safety compliance describes safety-related behaviors required by the organization to be carried out by individuals to keep the workplace safe. Safety participation depicts voluntary safety-related behaviors that may not directly work on personal safety but help to develop an organizational context to support safety (Griffin and Neal, 2000; Neal and Griffin, 2004; Neal et al., 2000). Safety performance in this study is considered to be the actual safety behaviors that individuals perform at work. The data related to safety compliance and safety participation are collected accordingly.

2.6 RELATIONSHIP BETWEEN SAFETY CLIMATE AND SAFETY PERFORMANCE

Safety climate is often considered a predictor of safety performance. Some researchers have even stated that safety climate measurement aims to provide inquiring and changing opportunities for improving safety performance in organizations (Carroll, 1998; Cooper and Phillips, 2004). To verify this predictive function, many studies have explored the relationship between safety climate and safety performance across diverse industrial settings, such as the offshore (Mearns et al., 2003), manufacturing (Zohar, 2000), and construction industries (Goldenhar et al., 2003). Several of these studies have shown significantly positive relationship between safety climate and safety performance (Gillen et al., 2002; Siu et al., 2004). However, questions on the existence of a significant relationship between safety climate and safety performance still remain (Glendon and Litherland, 2001). Figure 2.4 provides a general framework to describe the common potential relationship between safety climate and safety performance identified in previous research (Brondino et al., 2012; Griffin and Neal, 2000; Guo et al., 2016; Huang et al., 2006; Mearns et al., 2003; Meliá et al., 2008; Mohamed, 2002; Neal et al., 2000; Probst, 2004; Siu et al., 2004; Zohar, 2002). Three major kinds of relationships between safety climate and performance exist.

First, some studies have focused on the direct relationship between safety climate and safety performance (Mearns et al., 2003; Mohamed, 2002). Mohamed (2002) stated that a positive safety climate can lead to safe work behaviors. Mearns et al. (2003) found varied degrees of association between particular safety climate scales and statistical historical as well as self-reported accidents. Other studies have also indicated that different safety climate factor structures can result in vast differences in the relationship (Clarke, 2006). Cooper and Phillips (2004) evaluated the degree of association between the two constructs and found them to be moderate at most, and the actual relationship between them tend to be inflated and overestimated (Cooper and Phillips, 2004).

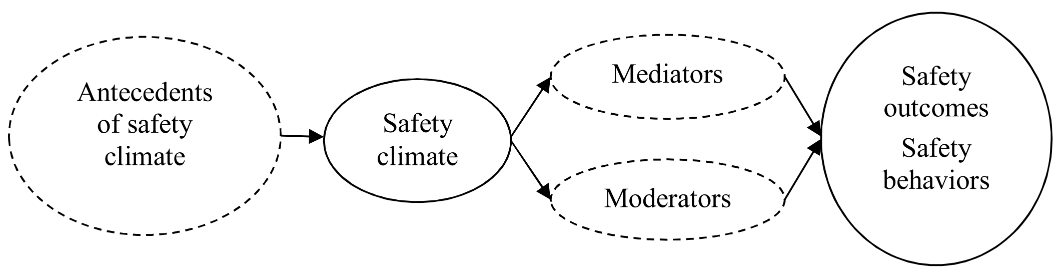


Figure 2.4 Summary of relationships between safety climate and safety performance

Second, the underlying mechanisms of the relationship between safety climate and safety performance have also been learnt (Brondino et al., 2012; Griffin and Neal, 2000; Guo et al., 2016; Huang et al., 2006; Meliá et al., 2008; Siu et al., 2004). After considering the difficulties of verifying the steady direct relationship between safety climate and safety performance, some researchers have investigated the indirect relationship of the two constructs and found that the relationship between safety climate and safety performance can be mediated by extra variables, such as work context, production, knowledge, skill, and motivation (Brown et al., 2000; Griffin and Neal, 2000; Hofmann and Stetzer, 1996), or moderated by extra variables, such as study design (Clarke, 2006). Siu et al. (2004) investigated the relations among safety climate, psychological strains, and accident rates and found that psychological strains are a mediator of the relationship between safety climate and accident rates (Siu et al., 2004). Huang et al. (2006) discovered that employee safety control is a mediator of the relationship between safety climate and self-reported injuries (Huang et al., 2006). Griffin and Neal (2000) identified that safety knowledge and safety motivation mediate the link between safety climate and safety performance (i.e., safety compliance and safety participation). Guo et al. (2016) extended the research of Griffin and Neal (2000) and tested an integrative model in the construction industry to understand the mechanisms on how particular safety climate factors affect workers' safety performance through individual factors (i.e., safety knowledge and safety motivation) (Guo et al., 2016). Melia et al. (2008) split up safety climate into different variables (i.e., organizational safety response, supervisors' safety response, coworkers' safety response, and workers' safety response) and examined a psychosocial sequence of relationships among these safety responses from top to bottom. Based on a similar framework to the study of Melia et al. (2008), Brondino et al. (2012) found that coworkers' safety response mediates the relationship between organizational safety response and safety performance as well as the relationship between supervisor safety response and performance using SEM method.

Third, some studies have tested the mediating or moderating relationship of safety climate between antecedents of safety climate, such as organizational factors, and safety performance (Neal et al., 2000; Probst, 2004; Zohar, 2002). Neal et al. (2000) stated that the relationship of organizational climate and safety performance is mediated by safety climate. Zohar (2002) indicated that transformational and constructive leadership predict injury rate in organizations with the mediation of safety climate components. Probst (2004) explained different findings on the topic of the relationship between job insecurity and employee safety outcomes based on the moderating effect of safety climate.

2.7 FACTORS AFFECTING SAFETY CLIMATE

Perceptions of organizational climate emerge from the interaction between organizational and individual factors. As an organic component of the organizational climate, safety climate may be influenced by organizational factors (e.g., company size, ownership type, safety manager, and location) (Wu et al., 2007) and individual factors (e.g., gender, age, marital status, number of family members supported, education level, smoking habit, drinking habit, job tenure, position, accident experience, safety knowledge, and safety training status) (Fang et al., 2006; Gillen et al., 2002; Gyekye and Salminen, 2009; Wu et al., 2007). Factors affecting safety climate have been studied in various sectors, such as manufacturing (Gyekye and Salminen, 2009), education (Wu et al., 2007), and construction (Fang et al., 2006; Gillen et al., 2002; Zhou et al., 2008). Safety climate can be influenced by many factors in the construction industry. A positive relationship is identified between safety climate and workers' age, marital status, and number of family members supported because construction workers often hold enhanced perceptions of safety climate with their increased social responsibilities (Fang et al., 2006). Education level is also an important factor for safety climate, and a positive association between education level and safety climate has been established in previous studies (Fang et al., 2006; Gyekye and Salminen, 2009; Zhou et al., 2008). A negative relationship is also noted between drinking habit and safety climate, leading to a policy of forbidding drinking at work to improve safety climate in the construction industry (Fang et al., 2006). Statistically significant differences in perceptions of safety climate are also identified between union and non-union workers in the US, and the union workers tend to possess more positive safety climate than the non-union workers (Gillen et al., 2002).

In addition, three specific factors that may affect safety climate in international construction projects are including nationality, religious belief, and employment mode are developed in this section.

2.7.1 Nationality

The research direction that focuses on the relationship between national culture and safety has received an increasing scholarly interest in recent years (Mearns and Yule, 2009; Mohamed et al., 2009; Starren et al., 2013). These studies are basically developed from Hofstede's cultural dimensions' theory (Hofstede, 1991), which establishes a systematic framework to assess national cultures from five cultural dimensions, namely, large vs. small power distance, individualism vs. collectivism, strong vs. weak uncertainty avoidance, masculinity vs. femininity, and short-term vs. long-term orientation. Among these studies, Mearns and Yule (2009) examined the relationships between Hofstede's cultural dimensions and risk-taking behaviors at work through a study of six national workforce groups, and confirmed that only masculinity and power distance can significantly predict risk-taking behaviors. Mohamed et al. (2009) verified that collectivism, femininity, and considerably high uncertainty avoidance can enhance workers' safety awareness and beliefs, thereby leading to significantly safe jobsite behaviors. Apart from national culture, nationality influences safety because of other reasons. Spangenberg et al. (2003) studied a bridge project between Sweden and Denmark and discovered that the accident rate among Swedish workers was four times that of Danish workers; however, both countries have similar scores on Hofstede's national cultural dimensions. This difference is explained by factors of several levels, including macro-level (e.g. national wage practices, national education programs, socioeconomic structure of the construction industry, and work environment legislation), meso-level (e.g. employment practices and work planning and preparation), and micro-level (e.g. training and learning and attitude toward work) factors. In our study, nationality is supposed to be a significant affecting factor for safety climate. A positive relationship between socioeconomic development level and safety climate is considered. As the international contractors investigated in our research get jobs in countries less developed than their own one, the following hypotheses are proposed in terms of the relationship between nationality and safety climate.

2.7.2 Religious belief

As workers in international construction projects origin from various countries and possess different values and cultures, they have different types of religious believes. Studies on the relationship between religious belief and safety are generally few. These studies focus on the relationship between safety and the cultural settings or values behind religious belief, rather than solely using religious belief as a statistical index. Fatalism, which is considered to have intersection with religious belief, plays a significant role in shaping individuals' risk perceptions of safety. Here the author implies neither that fatalism has only religious nature nor that religious individuals are inherently fatalistic. In a traffic safety-related study, fatalists were determined to have a relatively passive attitude toward both traffic risk perception and driver behaviors, as fatalists do not tend to be anxious toward matters they consider out of their personal control (Şimşekoğlu et al., 2013). In terms of construction safety, fatalism is considered to hinder workers' safety compliance in Middle East countries (Loney et al., 2012), and high perceptions of workplace hazards can result in increased workers' fatalistic orientation as well (Patwary et al., 2012). However, an entirely opposite opinion does exist that belief in or practice of a religion positively affect a person's approach to occupational health and safety (Smallwood, 2002), because of the inter-relationship among religion, morality, and values. Religion could also be seen as a moral commitment to acting in a determinate way. It works as a "supernatural police" to force people to perform under accepted rules (Torgler, 2006). Religiosity may reduce risk taking behavior to some extent. For example, some empirical studies show that counties with higher religiosity have significantly less violent and nonviolent crime (Evans et al., 1995). Similarly, a higher religiosity is also correlated with a higher tax morale (Alm and Torgler, 2006). In the present study, the positive opinion is considered and the following hypotheses have been proposed regarding the relationship between religious belief and safety climate.

2.7.3 Employment mode

A significant growth in the types of employment mode (e.g. temporary, part-time, and subcontract employment) is obvious at the present time due to product market uncertainty (Chiang, 2009; Manu et al., 2013). Many companies in construction sector are rather small and they obtain work as subcontractors (Manu et al., 2013). In international construction projects, outsourcing and subcontracting are common techniques of main contractors to obtain cost reductions and share risks (Kjellén, 2012). However, subcontracting is considered to be harmful to construction safety in numerous previous studies for several reasons (Chiang, 2009; Guldenmund et al., 2013; Manu et al., 2013). First, subcontracting is often paid based on the work done, and returns can increase with the rapid completion of work, thereby resulting in subcontractors neglecting safety when it impedes production (Chiang, 2009). Second, subcontracting tends to possess a transient nature; hence, workers have a considerable tendency to accept low safety standards (Guldenmund et al., 2013). Third, communication problems and subcontractors' unfamiliarity with the main contractors' safety practices can cause a challenging enforcement of unified safety and health regulations (Manu et al., 2013). Thus, subcontracted employees generally hold a more negative safety climate than directly employed workers (Fang et al., 2006). The following hypotheses have been proposed based on the relationship between employment mode and safety climate.

2.8 STRATEGIES FOR CONSTRUCTION SAFETY IMPROVEMENT

Dyck (2011) explained that the benchmarking in occupational health and safety strategies include 28 best practices that can serve as guidelines for practices. These best practices are demonstrating strong leadership, commitment and passion; striving to develop a high-performance work system; building a strong safety culture; incorporating occupational health and safety into company business strategies and planning; coordinating safety strategies, processes, and activities; creating safety requirements; creating and communicating policies, procedures, and practice standards; protecting the confidentiality of employee personal health information; clarifying safety ownership and responsibilities; promoting transformational leadership; investing in educating upper and line management on desired management practices; coordinating safety staffing and safety budgets; implementing an effective safety data management system; providing and integrating worker safety training; measuring safety performance; aligning company standards with recognized safety standards to measure uniformly safety programs; developing a safety communication strategy; striving for technology-driven safety awareness; implementing an effective disability management program; implementing a graduated return-to-work program; linking the company's safety program and disability management program; linking the safety program and employee assistance program; linking prevention to workplace injury management; adapting to a changing workforce; addressing workplace health and safety for new workers; protecting the contingent workforce; conducting more safety research; and obtaining safety research ideas to those who need it (Dyck, 2011).

2.8.1 Management commitment and safety leadership

Top management significantly influences safety management. Management commitment to safety, which involves management's safety attitudes and practices, is important for creating a positive safety culture (O'Dea and Flin, 2003). Safety performance can be improved significantly when top management is visibly involved in safety management, for example, spending time with field safety representatives (Hallowell et al., 2013). Dedobbeleer and Beland (1991) identified two most important factors of safety climate, i.e., management commitment and worker involvement. Hallowell and Gambatese (2009) found that active top management commitment is the single key factor for the reduction of injury rates (Hallowell and Gambatese, 2009a). According to Mearns and Yule (2009), sound management commitment to safety includes four aspects: prioritization of safety over production, top management attendance at safety meetings and other safety-related affairs, emphasis on safety in face-to-face meetings with employees, and inclusion of safety clause in job descriptions.

Safety leadership refers to the interaction process of leaders and workers to achieve safety management objectives in an organization (Wu et al., 2008). Interventions related to safety leadership activities have been approved to effectively improve safety management. Safety personnel play a key role in providing safety leadership when they carry out safety management tasks and develop positive safety culture (Zou and Sunindijo, 2013).

2.8.2 Sustainable safety culture

The term safety culture was initially introduced in the summary report of the Chernobyl Accident. Safety culture refers to a high priority placed on safety in the organization. Sound safety culture requires people to maintain, improve, and take responsibility for safety (Carroll, 1998). Four factors of safety culture are identified in a factor analysis study, i.e., management concern, personal responsibility for safety, peer support for safety, and safety management systems (Frazier et al., 2013). Hudson (2007) introduced a safety culture ladder to show a pathway from less advanced to advanced safety culture (Figure 2.5). The strategy for actually inducing this path needs to create lasting change. The advanced safety culture should be spread as marketing products rather than forcing regulations. People should first actively want the culture, and then they are provided with tools to achieve the culture (Hudson, 2007).

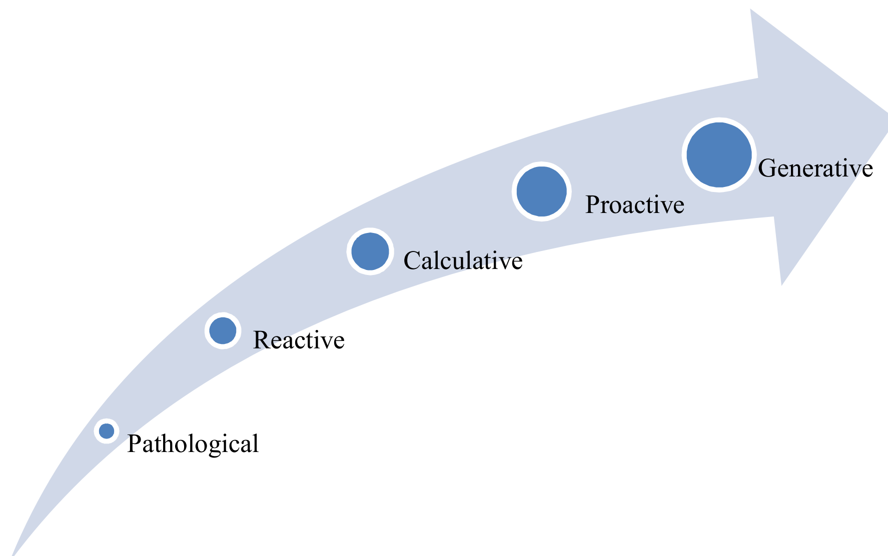


Figure 2.5 Safety culture ladder (Hudson, 2007)

2.8.3 Enforcement of safety standards and rules

Safety standards are stated approaches that specify the industry-acceptable level of safe work performance. Safety standards form the guidelines and rules for safety practices, provide boundaries for unsafe activities, clarify stakeholder roles and responsibilities for safety, and serve as a benchmark (Dyck, 2011; Raheem and Hinze, 2014). High safety standards in construction consist of all organizational, group, individual, and technical aspects, which specifically include: 1) project characteristics and nature, setting the boundaries of safety management; 2) planning, work roles, procedures, and resources; 3) collective values, norms, and behaviors; and 4) individual knowledge, ability, experience, and attitudes (Törner and Pousette, 2009).

Two types of safety standards exist in organizations, i.e., formal and informal. Formal safety standards form the structure of the company's safety management program, practices, and safe work procedures, which mainly include the documented company safety expectations, rules, and safety work practices. These standards are evident in safety management program manuals, employee handbooks, safety training, and safety communication materials. Informal safety standards are what have been done on the site when the workers think nobody is watching. The greater the gap between the formal and the informal safety standards, the higher the potential of incidents. Safety standards enable continuous improvement through the identification of gaps between the observed and the desired safety levels of performance. Making only formal safety standards and letting everybody know them are insufficient. The management should understand what is actually going on in the organization and monitor the level of safety compliance with the company's safety standards (Dyck, 2011).

2.8.4 Safety training and education

Safety training refers to providing employees with the information needed to perform the job safely. Safety training includes assisting the workers to develop the necessary skills in handling the job, as well as showing them the way to execute the job safely. The purpose of safety training is to ease the implementation of safety policies into specific job practices, and to raise employee awareness and skill levels to an acceptable safety standard. While all employees can benefit from safety training, special attention should be given to the training of supervisors, trainers, and young employees. A close relationship exists between safety training, work direction, work instruction, and work monitoring to ensure that the work is accomplished safely. Dyck (2011) lists five common safety training measures.

- Safety orientation. The related critical tasks, the safety program, and the safety culture to new employees should be introduced.
- Ongoing and updated safety training. New job hazards, new industry practices, and changes in the occupation and legislation should be introduced.
- On-the-job training. The potential hazards and the related control measures with hands-on explanation and demonstration should be explained.
- Refresher safety training. Providing ongoing safety training and encouraging employees to improve continually and update their knowledge and proficiency.
- Performance monitoring. Supervisors should identify ongoing safety training needs by monitoring employee performance.

2.9 CHAPTER SUMMARY

This chapter conducts a literature review that lays the foundation of the proposed research. It investigates: 1) accident causation and accident reduction; 2) international construction projects and safety management; 3) safety climate concept and measurement; 4) safety performance concept and measurement; 5) factors affecting safety climate; 6) relationship between safety climate and safety performance; and 7) strategies for construction safety improvement.

CHAPTER 3 METHODOLOGY

3.1 INTRODUCTION

This chapter presents the research design and research process employed in the current study. The adopted mixed method research design involves qualitative (i.e., document analysis and structured interview) and quantitative (i.e., questionnaire survey and Delphi survey) methods. Qualitative content analysis and constant comparison method were used to analyze qualitative data. Data analysis methods used to analyze quantitative data include descriptive statistics, EFA, CFA, SEM, hierarchical logistic regression analysis, and statistical test, which are also explained in this chapter.

3.2 RESEARCH DESIGN AND RESEARCH PROCESS

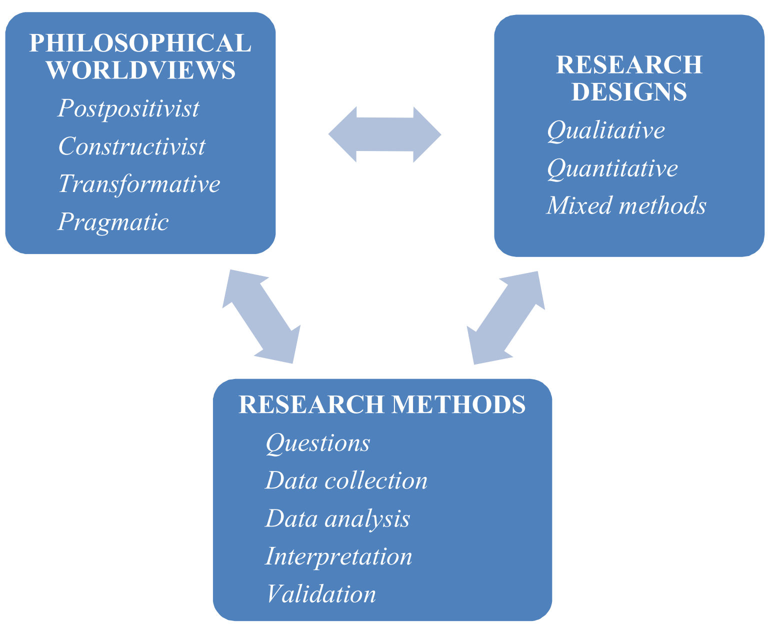


Figure 3.1 A framework for research (Creswell, 2013)

The research methodology aims to solve research problems systematically

(Kothari, 2004). The principles and procedures of rational thinking are utilized in scientific research (Fellows and Liu, 2009). Creswell (2013) iterates three interconnecting elements of a research framework, i.e., philosophical worldview, research design, specific methods, and procedures of research (Creswell, 2013). Figure 3.1 shows the interconnection relationships of these three components.

A philosophical worldview is "a general philosophical orientation about the world and the nature of research that a researcher brings to a study." The types of worldview of individual researchers bring about the utilization of qualitative, quantitative, or mixed method approach in their research (Creswell, 2013). Four types of philosophical worldviews are widely discussed in the literature, namely, post-positivism, constructivism, transformative pragmatism, and pragmatism. Post-positivism represents the traditional form of research, which begins with the development of a theory that is subsequently tested with empirical data. Constructivism posits that people develop subjective meanings of their experiences, and research relies on the opinions of participants regarding the situation studied. Transformative worldview considers that research should be connected with politics and an action agenda should be set to change the lives of participants. Pragmatism emphasizes research problems and suggests the application of all available approaches to understand and solve the problem (Creswell, 2013). As the current study focuses on safety management practices of overseas projects of CICs, a pragmatic worldview is applied in the research.

Research design presents the logical structure of the inquiry (De Vaus, 2001). Specifically, a detailed plan presents how an investigation will be conducted. The research design generally includes how data are collected, what tools are employed, and how data are analyzed. The common types of research design are qualitative, quantitative, and mixed methods (Creswell, 2013). Qualitative design focuses on qualitative data such as written or spoken narratives. Quantitative design focuses on quantitative data such as numbers and mathematical calculations. Mixed method design combines qualitative and quantitative designs to overcome the limitations of a single design. The qualitative research design includes narrative research, phenomenology, grounded theory, ethnography, and case study. The quantitative research design includes experimental and non-experimental designs such as surveys. The mixed method design includes convergent, explanatory sequential, exploratory sequential, and transformative mixed methods (Creswell, 2013). The mixed method research design is applied in the current study. Specifically, exploratory sequential mixed method is utilized in this study, indicating that the researcher begins exploring with qualitative data and analysis, and then uses the findings in a second quantitative phase.

Research methods refer to the specific means of data collection, data analysis, and interpretation. Throughout the research process in Figure 3.2, a large amount of qualitative and quantitative data was analyzed and validated. The data collection and data analysis methods that were utilized to achieve each of the research objectives are illustrated in Figure 3.2. The data collection methods include document analysis, structured interview, questionnaire survey and Delphi survey. The data analysis methods include qualitative content analysis, constant comparison, descriptive statistics, factor analysis, SEM, hierarchical logistic regression analysis, and statistical test. These methods are further introduced in the following two sections of this chapter.

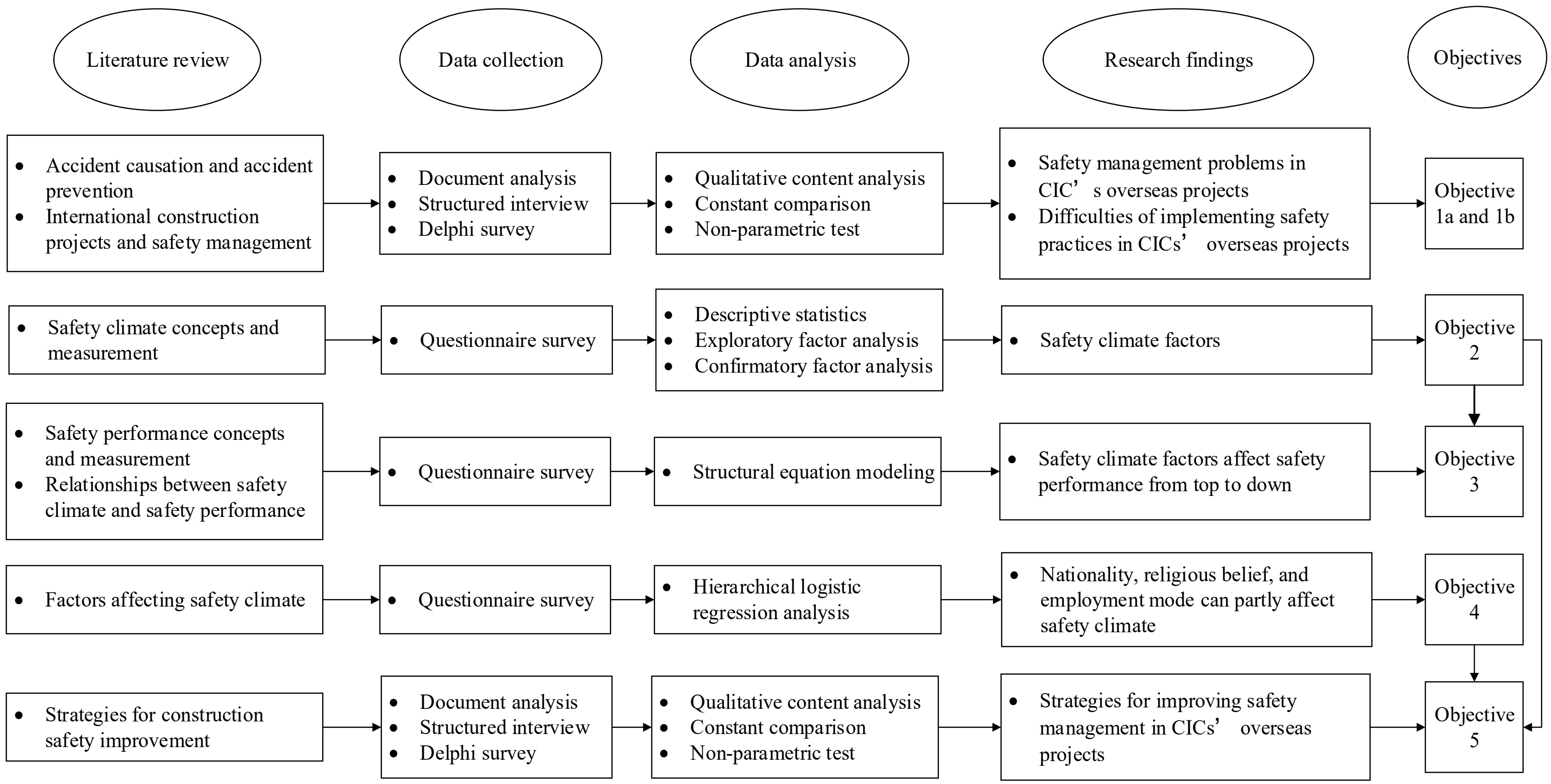


Figure 3.2 Research process of the study

3.3 DATA COLLECTION METHODS

3.3.1 Document analysis

Owing to the limited research information on safety management of CICs' overseas projects, collecting data with qualitative methods could efficiently reveal the actuality without imposing a predetermined framework by the researchers (Hon et al., 2012). Document analysis is a qualitative research method that requires the data to be examined and interpreted to gain an understanding and develop empirical knowledge from pre-existing documents (Bowen, 2009). Document analysis is particularly applicable to intensive qualitative case studies that produce rich descriptions of a single phenomenon (Yin, 2013). Documents could take a variety of forms, such as minutes of meetings, background papers, books, brochures, diaries, journals, and newspapers, and serve as primary sources of qualitative data. However, it needs to be clarified that analyzed documents often do not include research literature from previous studies, because literature requires the researcher provide the description and interpretation of data rather than has the raw data as a basis for analysis. The document analysis method has numerous advantages, including less time consumption, availability, cost effectiveness, stability, exactness, broad coverage, and lack of obtrusiveness and reactivity (Bowen, 2009).

In this study, documents on experience sharing in international construction projects of CICs were searched and reviewed. International contractors with hands-on experience are better informed of safety management practices as they are most likely to be people in proximity to accidents. Trade association website (i.e., China International Contractors Association) and trade journal (International Project Contracting & Labor Service) were considered as the main sources of the documentation. China International Contractors Association is the largest nationwide trade organization engaging in international project contracting. Its members have been operating in more than 180 countries and regions. It provides substantial experience sharing articles in international construction projects of CICs. International Project Contracting & Labor Service is the main trade journal for Chinese international contractors. “Safety management” and “construction safety” were searched as keywords on the trade association journal websites. Each article was reviewed through skimming, reading, and interpretation, and contextualized for further data analysis. A total of 50 articles were identified, among which 29 mentioned the host countries of international projects. The remaining 21 articles were based on an overall perspective. All these articles were in Chinese. Although these trade articles are kind of trade literature rather than primary sources, they are still considered as analyzed documents for the following reasons. First, trade journals are geared to practitioners in a subject, with the purpose of offering advice and tips to those in the trade. Second, trade journals report news and trends in a field, but not original research. Although there are some discussions in the trade article, they usually do not have references. In addition, some previous studies have considered trade journals and business journals as documents rather than literature. Figure 3.3 shows the regional distribution of international projects in the 29 experience-sharing articles.

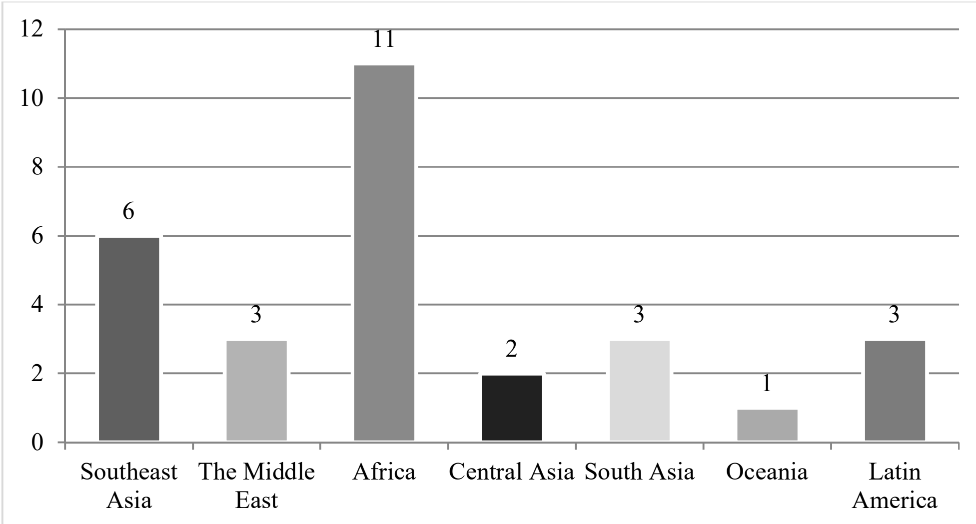


Figure 3.3 Region distribution of projects from document analysis

3.3.2 Structured interview

As an important data-collection strategy in qualitative research, the interview has been widely used in construction management studies (Fellows and Liu, 2009). In a research interview, the interviewer elicits from the interviewee various types of information. Interviews have three forms, namely, structured, semi-structured, and unstructured. The unstructured interview does not prearrange questions and allows for spontaneity during the interview process. The interview could go deeply into a topic and be suitable for gathering sensitive information. However, data collected through unstructured interviews could be prone to deviation, thereby resulting in low efficiency. As the opposite of the unstructured interview, the structured interview uses a prepared interview guide that lists the description and sequence of questions. This type of interview facilitates comparison of participant responses. The characteristics of the semi-structured interview falls between those of the two aforementioned interviews (Bryman, 2015). The structured interview method was adopted in the current study because it allows standardization of asking questions and recording answers, thereby minimizing differences among interviews.

To identify problems of safety management, difficulties in implementing safety practices, and strategies for improving construction safety in the overseas projects of CICs, a series of structured interviews were conducted between May and June 2014. The interviewees were selected carefully to ensure reliability and quality of the interviews. International contractors with hands-on experience were targeted for interviews because they are most likely to be people in proximity to accidents. All interviewees were expected to have participated in safety management in the CICs' overseas projects as project managers or safety officers. To increase heterogeneity of the interview panel, interviewees who had worked in various types of international construction projects from different countries or regions were selected. Invitations were sent to 13 experienced practitioners of Chinese international projects. Eight of them were willing to attend the interviews. Table 3.1 shows the backgrounds of these eight interviewees. A list of the interview questions was sent to each participant separately before the interview was conducted. These questions (Appendix A) were compiled with reference to research questions and literature. The personal information of each interviewee was collected at the beginning of the interviews. The author asked questions on the project background information and safety management issues related to the interviewee's projects. As most of the interviewees were working abroad when the interviews were conducted, only three were interviewed face-to-face during their vacations in China, whereas video interviews were conducted with five other respondents. The video interviews were conducted through Skype or QQ as per the convenience of the interviewees. Before the video interviews, equipment was debugged, and picture/ sound quality was preliminarily checked (Gillham, 2005). The interviewer did not set a time limitation, and the interview continued until the interviewee exhausted conversation topics. Each interview took approximately 45 to 90 minutes. The interviews were conducted in Chinese and recorded with prior consent from the interviewees, and all records were transcribed in English. Appendix D shows all interview reports transcribed in this study. The transcription was used for further data analysis.

Table 3.1 Background of the interviewees

No.	Position of interviewees	Work experience	Working place
A	Project construction manager	5 years	Africa
B	Project HSE manager	6 years	The Middle East
C	Project HSE manager	4 years	Asia
D	Project HSE manager	20 years	Asia
E	Project manager	20 years	The Middle East
F	Project manager	10 years	Africa
G	Project manager	20 years	Asia
H	Project HSEQ manager	10 years	Asia

3.3.3 Questionnaire survey

A questionnaire provides a set of questions that gathers information from respondents. Quantitative data are collected in a standardized manner, which ensures internal consistency and coherence for analysis. The two major types of questionnaires are open- and close-response (Guthrie, 2010). Open-response questionnaires gather comprehensive answers according to the words of the respondents and allow different answers from different interviewers. Closed-response questionnaires set predetermined options for selection and has lower validity than open-response ones because the choices might be restrictive.

However, close-response questionnaires have higher reliability because the set questions and answers make the research replicable. Categorical, checklist, ranked, and scaled are the four major types of closed-response questionnaires. The Likert scale is one of the most commonly used forms of scaled response. The respondents are asked to indicate their viewpoint by checking one of several response categories (Guthrie, 2010). The scale usually has a neutral center point, and five- or seven-point scales are most widely used (Denscombe, 2010). Effective questionnaires should be designed considering the educational levels of the respondents. The language used and context of the questions must be familiar to the respondents.

Questionnaires are effective in measuring people's perceptions (Choudhry et al., 2009). As a quantitative method, the questionnaire survey tends to be more cogent than qualitative methods in studying safety climate (Guldenmund, 2000; Mearns and Flin, 1999). A substantial number of studies on safety climate have used the form of self-explained questionnaires (Lingard et al., 2011b; Sunindijo and Zou, 2012). Thus, a questionnaire survey method is used to collect data related to safety climate in the current study. Due to limitation of time and funds, only CICs' projects in Vietnam were selected for data collection. The reasons for taking Vietnam as an example are as follows. First, according to the China Statistical Yearbook 2015, Vietnam ranked in the top 10 for value of turnover fulfilled by CICs in 2014 among over 200 countries and regions. The projects in Vietnam are therefore representative. Second, after conducting structured interviews, interviewees were asked to indicate their willingness or otherwise to introduce their workers to participate in the questionnaire survey. Two interviewees from Vietnam and one from the United Arab Emirates confirmed willingness and arranged their workers to participate in the study. The non-random procedure to select projects may pose a threat to the external validity of outcomes; thus, no action is made to extend the research findings to the entire industry (Lingard et al., 2012). Third, compared with other undeveloped and developing countries, Vietnam has a high literacy rate. According to World Bank data, adult literacy rate in Vietnam was 94.51% in 2015 (World Bank, 2015). The literacy rate for adult males in Vietnam was 96.28% for the aforementioned year; this detail is significant because most frontline workers on construction sites are male. The high literacy rate reduces obstacles in understanding questions and filling in questionnaires.

The questionnaire consists of three parts. The first part comprises personal particulars that assess the individual factors of the participants, including nationality, age, gender, marital status, number of family members supported, education level, religious belief, employment mode, and job tenure as well as smoking and drinking habits.

The second part is the safety climate scale. As discussed in Section 2.4.4, this study considers three agents related to safety climate, which are organization, supervisors, and coworkers. Items were adopted as follows: 16 items from Zohar and Luria (2005), 10 items from Zohar (2000), and 12 items from Brondino et al. (2013). These items measured the safety climate related to these three agents. All 38 items included in the questionnaire were adopted verbatim from previously tested and validated safety climate tools. As a holistic analysis of all reviewed items may provide a more complete result without compromising the importance of the reviewed items, no item was deleted from the original sets of questions. Sample items in this part are “Top management reacts quickly to solve the problem when told about safety hazards," "My supervisor seriously considers any worker's suggestions for improving safety," and "My coworkers constantly remind workers to work safely." The response to each item is measured on a five-point Likert scale, where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

The third part of the questionnaire is the safety performance scale. Safety performance in this study is considered as actual safety behaviors that individuals perform at work. A six-item safety performance scale from Neal and Griffin (2006) adopted verbatim to measure the actual safety behaviors. Although this scale was employed in the health care industry initially, the scale has been adopted to measure safety performance in the petrochemical industry (Jiang et al., 2010), as well as the construction industry (Hone et al., 2014). Among the six items, three are related to safety compliance and the other three to safety participation. Safety compliance denotes essential behaviors that workers should perform to maintain safety on site, while safety participation indicates behaviors that contribute to the development of an environment that supports construction safety. The items related to safety compliance include "I use all the necessary safety equipment to do my job," "I use the correct safety procedures to carry out my job," and "I ensure the highest levels of safety when I carry out my job." The items related to safety participation include "I promote the safety program within the organization," "I put in extra effort to improve the safety of the workplace," and "I voluntarily carry out tasks or activities that help to improve workplace safety." A five-point Likert scale is adopted to measure the response to each item from 1 to 5 in terms of strongly disagree, disagree, neutral, agree, and strongly agree.

The questionnaire was first developed in English and then translated into Chinese by the author. To ensure semantic consistency, a different translator was requested to translate the Chinese version back into English. Ambiguous words were mutually discussed and accepted by the author and aforementioned translator. Before the pilot questionnaires in English and Chinese were translated into Vietnamese, they were reviewed by 16 experts, including 7 academic staff members and 9 industrial practitioners. The selection criterion for academic staff was having experience in designing and administering questionnaire survey for construction management research, and four had relevant experience in safety climate questionnaire design. The criterion for industry practitioners was having adequate safety management knowledge/experience in international construction projects of CICs. They were requested to offer advice to ensure that the research objectives of this study were clearly expressed, and that these objectives were consistent with practical situations. Consequently, the responses of the experts necessitated several minor revisions to the expression of the items and the questionnaire format. The Chinese questionnaire was further translated into Vietnamese by a professional translation agency. To ensure semantic consistency, a different translator was requested to translate the Vietnamese version into English. Ambiguous words were fed back to the professional translation agency by the author and mutually accepted by the translators. The pilot questionnaire in Vietnamese was reviewed by three Vietnamese site translators engaged by CICs in Vietnam. All the site translators confirmed that Vietnamese frontline workers could fully understand the questionnaires.

The finalized questionnaires were administered to workers on six construction sites from three CICs in Vietnam. Appendix B shows the sample questionnaires in

English, Chinese, and Vietnamese versions administered in the current study. These projects were selected based on their availability to participate in this study. The nonrandom procedure to select projects poses a threat to outcome external validity; thus, no action is made to extend the research findings to the entire industry (Lingard et al., 2012). To ensure extensive participation and precise response from frontline workers, the author visited the aforementioned construction sites accompanied by a student assistant from the same university in May 2015, and personally coordinated with these workers with the assistance of interpreters. The research objectives were relayed to the participants patiently. The participants were further informed that the responses would remain confidential and their participation was voluntary.

3.3.4 Two-round Delphi survey

A Delphi survey was administered after completing qualitative data analysis and questionnaire survey. Delphi is a systematic and interactive research method for "structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem" (Linstone and Turoff, 1975). The aim of the Delphi method is to obtain the opinion of a group of separate experts on a particular topic (Hallowell and Gambatese, 2009b). The benefits of Delphi include reducing biases with participant anonymity, increasing suitability for groups with geographical distances, encouraging the participation of a wide range of experts, and ensuring participant involvement at the start (Biggs et al., 2013). The Delphi method is an iterative process that traditionally involves three or four rounds. Each round provides the same information and includes the group data of the previous round. The expert could modify his or her answer by considering group statistical data (Linstone and Turoff, 1975). To ensure participant involvement throughout the process, the Delphi method was modified to shorten the process with fewer rounds of survey (Biggs et al., 2013). The Delphi method generally includes selection of experts, development of questions, and analysis of responses (Xia et al., 2009).

The Delphi method is a frequently used method for item ranking in construction management (Ameyaw et al., 2016). This method is particularly suitable for ranking the relative importance of problems, difficulties, and strategies of safety management in the overseas projects of CICs for two reasons. First, this study requires involvement of practitioners with working experiences of safety management in international projects. General practitioners in the construction industry might not easily identify and prioritize problems, difficulties, and strategies of safety management in international projects. Second, the Delphi survey increases suitability for groups with geographical distances and involves practitioners from international projects located in various regions, thereby generating an unbiased research result.

In the current study, a two-round Delphi survey with 26 experts was conducted to rate the problems, difficulties, and strategies of safety management in the overseas projects of CICs. Appendix C shows the content of the Delphi survey. The items were obtained from document analysis, structured interviews, and questionnaire survey. The selection of appropriate experts is important to the success and validity of the Delphi survey. The selection requirements for experts include 1) adequate safety management knowledge/experience in international construction projects, and 2) work experience in different geographical areas as panelists with varied backgrounds tend to embrace a wide scope of knowledge (Hon et al., 2012). The 26 participants who met the aforementioned criteria were willing to participate in the two rounds of Delphi survey. A minimum of 8 to 12 panelists were required to implement the Delphi survey in the construction management research (Hallowell and Gambatese, 2009b). Thus, the number of experts in this study is considered sufficient to produce reliable results.

Table 3.2 shows the backgrounds of these experts. Eight experts worked in Southeast Asia, seven in the Middle East, and another eight in Africa. Three experts were included from regions other than those mentioned. According to the China Statistical Yearbook, Southeast Asia, the Middle East, and Africa accumulated almost two-thirds of the total value of turnovers fulfilled by CICs in 2014 (National Bureau of Statistics, 2015). Thus, these regions of the selected experts are representative.

In the first round of Delphi survey, all experts were asked to rate the importance of the proposed problems, difficulties, and strategies of safety management in the international construction projects of CICs based on a five-point Likert scale. The mean ratings of the items were calculated based on data from the first round of Delphi survey, and then fed back to the experts for re-rating the items in the second round of Delphi questionnaire.

Table 3.2 Background of experts

Experts	Position	Work experience	Regions
1	Chief engineer	11-20 years	Southeast Asia
2	Safety and quality manager	11-20 years	Southeast Asia
3	Heath, safety, and environment manager	6-10 years	Southeast Asia
4	Safety manager	6-10 years	The Middle East
5	Heath, safety, and environment manager	6-10 years	The Middle East
6	Safety manager	1-5 years	Southeast Asia
7	Manager	1-5 years	Africa
8	Project manager	6-10 years	The Middle East
9	Project manager	11-20 years	The Middle East
10	Director	6-10 years	Africa
11	Deputy manager	6-10 years	Southeast Asia
12	Manager	6-10 years	Southeast Asia
13	Project manager	11-20 years	Africa
14	Manager	11-20 years	The Middle East
15	Manager	6-10 years	Africa
16	Site engineer	11-20 years	Southeast Asia
17	Director	6-10 years	Others
18	Deputy manager	11-20 years	Africa
19	Project manager	6-10 years	Africa
20	Deputy director	6-10 years	Others
21	Chief engineer	over 20 years	Southeast Asia
22	Deputy manager	6-10 years	Africa
23	Civil engineer	6-10 years	The Middle East
24	Deputy manager	11-20 years	The Middle East
25	Deputy project manager	over 20 years	Others
26	Safety manager	6-10 years	Africa

3.4 DATA ANALYSIS METHODS

3.4.1 Qualitative content analysis and constant comparison

Qualitative content analysis is a foundational method in qualitative analysis. The process of qualitative content analysis contains an elaborative, intensive, and repeated reading and reviewing of the data. Based on data characteristics, researchers select the unit of analysis, categorize, and find themes from categories (Cho and Lee, 2014). Qualitative content analysis could be used inductively or deductively. The inductive approach means that the concepts are derived from the data and often used when no previous studies exist or when studies related to the topic are fragmented. The deductive approach means that the analysis structure is formulated according to previous knowledge, and is generally utilized to test a previous theory in a different situation (Elo and Kyngäs, 2008). The inductive approach is applied in the current study. Figure 3.4 shows the process of preparation, organizing, and resulting phases in the qualitative content analysis using inductive approach.

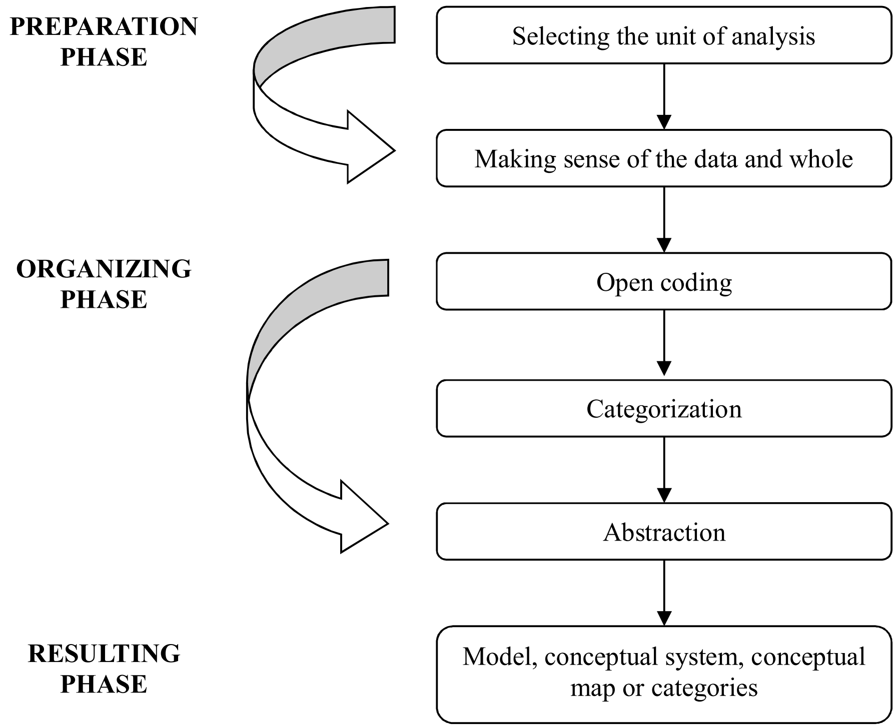


Figure 3.4 Preparation, organizing and resulting phases in the content analysis process adapted from Elo and Kyngäs (2008)

Qualitative content analysis could sometimes be confused with grounded theory. The main difference between the two is that grounded theory includes theoretical sampling, whereas qualitative content analysis does not (Cho and Lee, 2014; Forman and Damschroder, 2008; Hsieh and Shannon, 2005). Because the identified documents were in Chinese and the transcriptions of interviews were in English, these two kinds of materials were separately coded initially and the results were merged together then. A three-step constant comparative method were adopted to conduct qualitative data analysis in Nvivo 11. The constant comparison procedure is composed of the following: 1) comparison within a single document or interview, 2) comparison between documents or interviews within the same group or region, and 3) comparison of documents or interviews from different groups or regions.

3.4.2 Descriptive statistics

To obtain an overall picture of the data collected, descriptive statistics, such as frequency, mean, and standard deviation, were generated. Cronbach's alpha coefficient, which ranges from 0 to 1 based on the average inter-item correlation, was employed for internal consistency and reliability tests of the questionnaire. A high Cronbach's alpha score denotes a construct with considerably high internal consistency and reliability. The accepted value of the coefficient is 0.7 or above (Litwin, 1995; Zhou et al., 2010). It is considered that the questionnaire is reliable when scores approximate or exceed this threshold.

3.4.3 Exploratory factor analysis

Data were randomly split in two parts in the SPSS for Windows 17.0 software package (Hon et al., 2013). Approximately half of the data were used to conduct EFA as calibration samples in SPSS for Windows 17.0, and the remaining data were submitted to SEM as validation samples in Analysis of Moment Structures (AMOS) version 17.0.

EFA and CFA are two discrete types of factor analysis. The originally defined factor analysis is now called EFA, which is a powerful method to reduce variable complexity to greater simplicity by summarizing a larger quantity of variables to a smaller quantity of factors (Thompson, 2004). EFA allows the analysis to be concentrated on the principal components to acquire knowledge on the dynamics of their relationships. In the current study, EFA is used to identify the factor structure of the safety climate. Before EFA, both Kaiser-Mayer-Olkin (KMO) measure of sampling accuracy and Bartlett's test of sphericity were conducted to evaluate the appropriateness of using the EFA method in this study. As a frequently used extraction method whenever EFA is conducted, principal component analysis (PCA) was selected for data extraction in the current study. In this method, variables are put together according to their mutual correlations, and then combined to a certain number of components (Choudhry et al., 2009). To find out the number of factors that should be extracted and interpreted, parallel analysis was conducted in addition to Kaiser's criterion and scree test. According to Pallant (2007), parallel analysis is more accurate to determine the number of factors to be interpreted as the other two methods have a tendency to overrate the number of factors (Pallant, 2007). Oblimin oblique rotation method was used to interpret latent variables underlying a factor due to potential correlations among these factors. The threshold of 0.50 was considered as the minimum factor loading when determining an item to load on a latent factor (Lingard and Sublet, 2002). The factors obtained from EFA were further verified and relationships among them were investigated by SEM.

3.4.4 Structural equation modeling

SEM was conducted to assess the measurement model and test the potential theoretical relationships in the current study. SEM has been used pervasively in many scientific fields because of the provision of a comprehensive method for the quantification and testing of theories. With consideration of measurement error, SEM could estimate the theoretical relationships accurately and investigate a series of relationships concurrently (Ullman, 2006). Four types of commonly used structural equation models exist, namely, 1) path analysis, 2) CFA, 3) structural regression, and 4) latent change (Raykov and Marcoulides, 2006). The appropriate application of SEM requires at least three basic assumptions to be met, which are multivariate normality, matrix to be analyzed, and sample size. The bottom line of the sample size is supposed to be 200. However, researchers should consider model complexity and the number of estimated parameters, and each should have at least five participants to support (Crowley and Fan, 1997).

A large number of applications of SEM have been found in previous safety climate research (Cigularov et al., 2013; Fogarty and Shaw, 2010; Johnson, 2007; Goldenhar et al., 2003; Mohamed, 2002; Silva et al., 2004). For example, Silva et al. (2004) tested the association between organizational and safety climate contents by using SEM. Mohamed (2002) employed SEM to test the relationship between safety climate and safety behaviors in construction site environments. Goldenhar et al. (2003) applied SEM to examine the relationships among a variety of job stressors, including safety climate, injury, or near-miss outcomes, among construction workers. Johnson (2007) exploited SEM to identify the predictive validity of the safety climate questionnaire. Fogarty and Shaw (2010) applied path analysis method to clarify the mechanisms underlying the links between climate and behavior based on the theory of planned behavior. Cigularov et al. (2013) used multi-group CFA to investigate the measurement equivalence of safety climate across 10 groups of different construction trades. SEM methodology is quite appropriate for this study, as the system allows safety climate factors and safety performance to be tested at the same time.

AMOS version 17.0 was used in the current study. For model estimation, maximum likelihood method was applied. The structural equation model was tested in two stages of verifying the measurement and structural models. Internal validity and reliability of the model were assessed with calculating average variance extracted (AVE) and construct reliability (CR). A value over 0.50 of AVE and a value over 0.70 of CR suggest good validity and reliability, respectively (Hair, 2010). Model complexity, internal validity, and reliability were first accessed within every construct, and then in an aggregated measurement model (Shen, 2013). For model evaluation, a number of frequently used fit indices were adopted in the current study, including the ratio of model chi-square to the degrees of freedom (χ^2/df), root mean square error of approximation (RMSEA), goodness-of-fit (GFI), adjusted goodness-of-fit (AGFI), Tucker–Lewis index (TLI) and comparative fit index (CFI). A χ^2/df value less than 5 indicates an acceptable model fit to the data. RMSEA values of less than 0.05 indicate a good fit, whereas values ranging from 0.05 to 0.08 are acceptable. GFI, AGFI, TLI and CFI all range from 0 to 1. Values over 0.80 are considered an acceptable model fit to the data. Mediations were considered in SEM. Bootstrap method was selected in AMOS version 17.0. Mediation effect exists if the bias-corrected interval for the indirect effect does not include zero. If the bias-corrected interval for the direct effect includes zero, full mediation effect exists, and if not, partial mediation effect exists (Shrout and Bolger, 2002).

3.4.5 Hierarchical logistic regression analysis

Hierarchical logistic regression analysis was performed to determine the extent by which safety climate dimensions were predicted by nationality, religious belief, and employment mode. The hierarchical procedure was designed to reflect a progression from control variables to study variables. Logistic regression is a mode of regression used when the dependent variable is categorical, and the independent variables are of any type (Field, 2009). Given that several independent variables were binary variables in this study, logistic regression was selected. The dependent variables were measured using a five-point Likert scale initially. Therefore, these variables were changed into new dichotomous variables by subtracting their respective means. The positive number was changed into 1, which implied a good safety climate. By contrast, the rest was changed into 0, which signified a poor safety climate. The independent variables were entered progressively to study the variance changes in different models. Two sets of independent variables were gradually entered. The control variables (i.e., age, gender, marital status, number of family members supported by the participants, education level, smoking habit, drinking habit, and job tenure) were entered as a group in the first step. The study variables (i.e., nationality, religious belief, and employment mode) were added in the second step. The variables were stepped up to indicate how much additional variance was explained when new variables were considered in the model. In each step, the significance of the overall or full model was assessed, as well as the total amount of variance explained (R^2).

3.4.6 Statistical test

A statistical test was conducted on two rounds of the Delphi survey. The mean ratings of each item were calculated and ranked. To assess the degree of agreement among the experts, Kendall's coefficient of concordance (W) was calculated using SPSS. The relative strength of the agreement and increasing tendency could be determined using Kendall's W (Schmidt, 1997). The W value of 0 represents lack of agreement among experts, whereas 1 means perfect agreement. In addition to Kendall's W, chi-square values were calculated as near approximation because the number of items for each part was greater than 7 (Siegel and Castellan, 1988). Wilcoxon signed-rank test was used to compare the repeated measurements in two rounds of Delphi survey by assessing the mean ranks. A significant Wilcoxon signed-rank test represents significant difference between the expert ranks in the two rounds (Ameyaw et al., 2016). Kruskal-Wallis test was used to compare the expert ranks on each item from different groups including Southeast Asia, the Middle East, Africa, and others. A significant Kruskal-Wallis test result indicates that agreement among subgroups cannot be achieved (Hon et al., 2012).

3.5 CHAPTER SUMMARY

To achieve the study objectives, appropriate research methods have been assessed and selected. Both qualitative (i.e., document analysis and structured interview) and quantitative methods (i.e., questionnaire survey and Delphi survey) are adopted in the current study. Data analysis methods were used to analyze questionnaire data that included descriptive statistics, hierarchical logistic regression analysis, factor analysis, and SEM.

CHAPTER 4 SAFETY MANAGEMENT PROBLEMS AND DIFFICULTIES OF IMPLEMENTING SAFETY PRACTICES IN CICS' OVERSEAS PROJECTS

4.1 INTRODUCTION

This chapter presents the research findings related to Objective 1a and 1b, which examines the safety management problems and difficulties of implementing practices in CICs' overseas projects. Major safety management problems and difficulties of implementing safety practices in CICs' overseas projects are identified from Delphi survey and discussed in this chapter.

4.2 SAFETY MANAGEMENT PROBLEMS IN CICS' OVERSEAS PROJECTS

4.2.1 Problems identified from qualitative data analysis

After conducting document analysis and structured interviews, 16 problems of safety management in CICs' overseas projects were formulated. Table 4.1 shows the frequencies of safety management problems in the overseas projects of CICs mentioned in document analysis and structured interviews. These numbers represent the exact quantity of interviewees and experts who indicated that each of the key themes is the problem faced in safety management. Inadequate safety budget, poor execution of safety management on site, the top management of CICs lack commitment to construction safety, inefficient safety inspection and supervision, weak safety awareness of local workers, and language barriers lead to poor safety communication are the most frequent problems identified from document analysis. Language barriers lead to poor safety communication and safety plan becomes a mere formality are the most frequent problems identified in the structured interviews.

Table 4.1 Problems of construction safety management in CICs' overseas projects

Items	Description	Document analysis	Structured interviews
P01	CICs lack contracting and management experience in the project host country.	6	0
P02	The top management of CICs lack commitment to construction safety.	7	2
P03	Unclear responsibility for construction safety in CICs' overseas projects.	3	1
P04	Health and safety plan becomes a mere formality.	5	5
P05	Poor execution of safety management on site lead to potential safety hazard.	8	3
P06	Inefficient safety inspection and supervision.	7	3
P07	Inadequate safety budget.	10	3
P08	Short of professional safety staff.	2	1
P09	Backward construction safety technology and equipment.	0	1
P10	Insufficient supply of PPEs in good quality.	2	1
P11	Inadequate safety training and education.	1	3
P12	Mental and physical fatigue of Chinese workers.	1	1
P13	Weak safety awareness of local workers.	7	2
P14	Low safety management ability of local subcontractors.	5	3
P15	CICs lack safety control of subcontractors after contracting.	1	0
P16	Language barriers lead to poor safety communication.	7	6

Inadequate safety budget

An adequate safety budget is the basis of reducing accidents and improving safety management. The lack of safety input is the most common safety management problem in overseas projects of CICs. Various Chinese enterprises win bids with low prices, thereby reducing the budget of both contractors and subcontractors and causing insufficient input to safety management. In addition, contractors cannot easily claim compensation because of delays during project, which further reduce the safety budget.

Poor execution of safety management on site causes potential safety hazard

Poor safety management on sites and irregularities during construction can cause potential safety hazards. These irregularities, such as the unsuitable protection of soil during excavations, deficient scaffoldings and ladders, unprotected open edges, unclear safety notices, improper use of personal protective equipment, unsatisfactory maintenance of machinery and equipment, and electrical safety hazards, may result in accidents and injuries.

The top management of CICs lack commitment to construction safety

The active commitment of the top management of CICs is crucial for the reduction of injury rates on construction sites. Although construction safety is highlighted in the sites of CICs' overseas projects, various problems related with poor safety awareness and the lack of management commitment of the top management and project managers exist. Production is often prioritized over safety. Members of the top management seldom personally attend safety meetings and other safety-related affairs. Safety clauses and requirements are often ignored in job descriptions.

These situations make safety management a mere formality.

Inefficient safety inspection and supervision

Safety supervision and inspection can help achieve safety goals on construction sites. Safety inspections and audits should be consistently carried out, and subsequent corrective actions should be further performed. In CICs' overseas projects, safety inspection mainly focuses on unsafe physical conditions on sites, such as the safety of machinery, housekeeping, opening protection, scaffolding, and personal protective equipment. Safety supervision, such as observation of unsafe behaviors and frequency of near misses, is often ignored.

Weak safety awareness of local workers

Many overseas projects of CICs are located in less developed countries. Local workers employed on construction sites probably know little about safety awareness. They tend to believe that accidents are unavoidable, and they hold a negative attitude toward accident prevention. They lack the knowledge for working at height, using personal protective equipment and considering emergency procedures. Interviewee C remarked, "As the weather is relatively hot, many local workers prefer to wear shorts and T-shirts on site, and many of them even do not wear shoes at all. We exerted considerable efforts to change this problem, and we even gave them free shoes. However, many local workers are still barefoot on site because they find it comfortable to not wear shoes. In order to work conveniently, many local workers also do not wear other PPEs".

Language barriers cause poor safety communication

Poor safety communication often occurs on construction sites of CICs' overseas projects. Language barriers pose serious challenges to the safety management. A rough estimate showed that one occupational accidents in ten in the process industry were caused by communication problems due to language issues (Paul, 2013). Although translators or interpreters are employed, onsite translation could result in ineffective verbal communication because of wrong interpretations or translations. Language barriers are also difficult when addressing cases of emergency, thereby transforming avoidable situations into accident cases. Written communication is also deficient in workers. Safety notices, posters, and signage signs are not always translated into Chinese, English, and local languages, and some of the workers cannot understand these materials well.

Safety plan becomes a mere formality

Although safety schemes and plans are commonly formulated according to requirements, they are often treated as a paper exercise and yield insufficient benefit in the overseas projects of CICs. Safety plans are often created to satisfy the requirements of clients, instead of being used as effective tools. According to Interviewee B, "Although safety schemes are proposed, they are often left on the shelf on site."

4.2.2 Relative importance of the identified problems

To have a deeper understanding of the qualitative findings, a two-round Delphi survey with 26 experts was conducted to rate the problems of safety management in the overseas projects of CICs. Statistical data analysis was conducted on two rounds of the Delphi survey. Mean ratings and rankings are shown in Tables 4.2 and 4.3. After conducting the survey, the whole expert panel identified five most important problems of safety management in the overseas projects of CICs. These problems were weak safety awareness of local workers, low safety management ability of local subcontractors, inadequate safety budget, mental and physical fatigue of Chinese workers, and unclear responsibility for construction safety in CICs' overseas projects.

Tables 4.2 and 4.3 show that the Kendall's W values of all experts in the two rounds were 0.155 and 0.211. W values increased in a sequential round of Delphi survey. Significant consensus among all experts was confirmed. The chi-square values for all experts in the two rounds of survey were 60.602 and 82.193, which were statistically significant. Thus, the two-round Delphi survey successfully improved agreement among all experts and the reliability of results. Rating agreements were also improved within the groups of Southeast Asia and the Middle East at significant levels. The Kendall's W value of the Southeast Asia group increased from 0.23 in the first round to 0.275 in the second round, and that of the Middle East group increased from 0.291 in the first round to 0.332 in the second round. Although W value of the Africa group could not reach significant level in the first round of survey, significant consensus was confirmed in the second round. The Kendall's W value of the Africa group in the second round was 0.336. The Kendall's W values for the others group were not significant in two rounds of survey. The Wilcoxon signed-rank test was used to compare the repeated measurements in two rounds of Delphi survey. Table 4.4 shows that all 16 items were insignificant, which indicates that lack of significant difference between the ranks of experts of items in the two rounds.

Table 4.2 Results of round-one Delphi survey: Problems of construction safety management in CICs' overseas projects

Items	All experts		Southeast Asia		The Middle East		Africa		Others		Kruskal-Wallis test
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Asymp. sig.
P01	3.12	6	2.88	9	3.57	3	3.63	4	1.33	16	.031
P02	2.65	15	2.50	14	2.71	13	3.00	12	2.00	12	.625
P03	3.19	5	3.13	4	3.43	4	3.13	9	3.00	3	.958
P04	2.85	11	2.75	11	3.00	10	3.13	9	2.00	12	.436
P05	3.04	8	3.00	6	3.14	8	3.25	7	2.33	7	.494
P06	2.77	12	2.63	12	3.14	8	2.88	15	2.00	12	.370
P07	3.42	3	2.88	9	3.86	2	3.75	2	3.00	3	.315
P08	3.12	6	2.63	12	3.29	7	3.75	2	2.33	7	.212
P09	2.96	10	3.00	6	3.43	4	2.75	16	2.33	7	.537
P10	2.73	14	3.00	6	2.57	14	3.00	12	1.67	15	.349
P11	2.77	12	2.50	14	2.86	11	3.13	9	2.33	7	.765
P12	3.23	4	3.13	4	3.43	4	3.50	6	2.33	7	.463
P13	3.85	1	4.25	1	2.86	11	4.25	1	4.00	1	.253
P14	3.73	2	3.63	2	4.00	1	3.63	4	3.67	2	.838
P15	2.38	16	2.13	16	1.71	16	3.00	12	3.00	3	.177
P16	3.04	8	3.38	3	2.57	14	3.25	7	2.67	6	.551
Number (n)	26		8		7		8		3		
Kendall's W	.155		.230		.291		.202		.519		
Chi-Square	60.602		27.552		30.582		24.256		23.346		
Asymp. Sig.	.000		.025		.010		.061		.077		

Table 4.3 Results of round-two Delphi survey: Problems of construction safety management in CICs' overseas projects

Items	All experts		Southeast Asia		The Middle East		Africa		Others		Kruskal-Wallis test
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Asymp. sig.
P01	3.08	6	2.63	12	3.43	6	3.5	4	2.33	9	0.046
P02	2.62	14	2.38	15	3.14	8	2.75	11	1.67	15	0.177
P03	3.15	4	3	7	3.57	3	3.13	7	2.67	5	0.583
P04	2.69	13	2.75	9	2.86	11	2.88	10	1.67	15	0.180
P05	3	7	3.13	4	3	10	3	8	2.67	5	0.679
P06	2.62	14	2.63	12	2.86	11	2.63	14	2	13	0.508
P07	3.42	3	3	7	3.57	3	3.88	2	3	3	0.270
P08	3	7	2.63	12	3.29	7	3.38	5	2.33	9	0.389
P09	2.77	11	2.75	9	3.57	3	2.25	16	2.33	9	0.150
P10	2.73	12	3.13	4	2.57	15	2.75	11	2	13	0.435
P11	2.92	9	2.75	9	2.86	11	3.25	6	2.67	5	0.801
P12	3.15	4	3.13	4	3.71	2	3	8	2.33	9	0.263
P13	3.81	1	4.25	1	3.14	8	4	1	3.67	1	0.359
P14	3.69	2	3.63	2	3.86	1	3.63	3	3.67	1	0.888
P15	2.35	16	2.13	16	2.14	16	2.5	15	3	3	0.509
P16	2.88	10	3.25	3	2.71	14	2.75	11	2.67	5	0.595
Number (n)	26		8		7		8		3		
Kendall's W	.211		.275		.332		.336		.452		
Chi-Square	82.193		32.997		34.812		40.295		20.335		
Asymp. Sig.	.000		.005		.003		.000		.159		

Table 4.4 Wilcoxon Signed-Rank test of two rounds Delphi survey results: Problems of construction safety management in CICs' overseas projects

Items	Wilcoxon Signed-Rank test	
	Z-value	Asymp. Sig.
P01	-.302	.763
P02	-.333	.739
P03	-.378	.705
P04	-1.414	.157
P05	-.378	.705
P06	-1.414	.157
P07	.000	1.000
P08	-1.000	.317
P09	-1.508	.132
P10	.000	1.000
P11	-1.414	.157
P12	-.707	.480
P13	-.277	.782
P14	-.447	.655
P15	.000	1.000
P16	-.811	.417

4.2.3 Agreement of experts from different regions

The Kruskal-Wallis test was used to compare the opinions of experts among various region groups. Insignificant result indicates that agreement is achieved among different region groups. As shown in Table 4.2, the Kruskal-Wallis test confirmed only one item to be significant in the first round. Inter-group comparison indicates that even though the experts work in different regions, they have similar opinion toward the problems of safety management in CICs' overseas projects on most items. In other words, the identified safety management problems in the overseas projects of CICs are generally recognized across regions. The Kruskal-Wallis test in the second round remains the same (Table 4.3), showing that experts from different regions failed to reach agreement on the item of “CICs lack contracting and management experience in the project host country”.

4.2.4 Discussions

The findings obtained from both structured interviews and Delphi survey emphasized the problems regarding low safety awareness of local workers and inadequate safety budget in overseas projects of CICs. The Delphi survey results also highlighted the low safety management ability of local subcontractors, mental and physical fatigue of Chinese workers, and unclear responsibility for construction safety in the overseas projects of CICs.

Given that the overseas projects of CICs are located mainly in undeveloped and developing countries, the price of local labor and compensation standards for accidents is low. For example, the compensation for fatal accidents is only equivalent to one year’s wage in the country of Interviewee F, whereas that in China is 20-fold of that in a city. The inadequate valuation of life leads to a low level of safety awareness and poor safety performance. The relationship between low socio-economic development and poor safety performance can be explained through Maslow’ hierarchy of needs, which states that workers only pursue safety or security needs after fulfilling their basic physiological needs (Mearns and Yule, 2009). The low safety awareness and fearless attitude of construction workers toward safety are evident in many developing countries. A positive attitude toward safety is encouraged among construction workers. They should be aware of the risk related to their work and realize that working in such a risky environment is not exciting. Workers should also trust the management, understand their common safety responsibilities to prevent accidents, and be confident about their abilities to identify safety hazards (Mohamed et al., 2009).

Safety budget is the cost incurred due to an emphasis on safety control in terms of employing safety personnel, safety training, personal protective equipment, safety incentives, or other activities, which are carried out to reduce accidents (Feng et al., 2014). A sufficient safety budget from the perspective of contractors (main contractors and subcontractors) is important for projects. Low-bid-price wars occur among CICs because of intense competition. Consequently, budgets and profits are substantially reduced (Zhao and Shen, 2008). CICs are encouraged to avoid blind internal competition and ensure sufficient budgets, especially safety budgets.

The low safety management ability of local subcontractors in the overseas projects of CICs must be addressed. Subcontracting is considered detrimental to safety management (Chiang, 2009; Guldenmund et al., 2013; Manu et al., 2013). Workers from labor subcontractors are often paid based on output, and returns can increase with rapid work completion; therefore, subcontractors neglect safety when it impedes production (Chiang, 2009). As subcontracting is transient in nature, workers may not receive sufficient safety training and education (Guldenmund et al., 2013).

Mental fatigue among Chinese workers also often occurs on construction sites and causes poor safety performance. According to Interviewee A, "During the first two years of the project, no fatality accident happened among Chinese workers. However, the following two years, there were four fatalities… It is because of mental fatigue. The long-term boring life out of their home country makes workers minds numb". Interviewee B also stated, "Given the unfamiliar environment, harsh climate, distasteful food supply, bad accommodation condition, and lack of entertainment, many Chinese workers suffer from severe depression and mental fatigue. These risky emotional and mental conditions increase safety risks. One time in my project, over 10 Chinese workers called in sick in the same day. Moreover, some sick workers force themselves to work to earn daily wages, which highly threatens safety management on site".

Safety responsibility is about whose role is to ensure safety on construction sites. Both management and workers should be responsible for their safety. Top management is the most responsible about construction safety on sites and for the protection of all workers. Supervisors should make workers completely aware of safety hazards and ensure that they work safely. Workers should report hazards in the workplace and follow safe work practices. Furthermore, safety responsibility charts outlining the safety responsibilities of all involved personnel on construction sites, including both main contractors and subcontractors, must be visible in the sites (Debrah and Ofori, 2001).

4.3 DIFFICULTIES OF IMPLEMENTING SAFETY PRACTICES IN CICS' OVERSEAS PROJECTS

4.3.1 Difficulties identified from qualitative data analysis

After conducting document analysis and structured interviews, 16 difficulties of implementing safety practices in CICs' international construction projects were formulated. Table 4.5 shows the frequencies of difficulties of implementing safety practices in the overseas projects of CICs mentioned in document analysis and structured interviews. Differences in socio-economic development, geographical climate, and customs in the project host country and China, as well as tough projects (e.g., complex design, tight schedule) are the most frequent difficulties identified from document analysis. Language barriers among project participants, different geographical climate and customs in the project host country and China, and difficulty in changing weak safety awareness of local workers are the most frequently mentioned difficulties in the structured interviews.

Table 4.5 Frequencies of difficulties of implementing safety practices in CICs' overseas projects

Items	Description	Document analysis (n=50)	Structured interviews (n=8)
D01	Different socio-economic development in the project host country and China.	25	3
D02	Different geographical climate in the project host country and China.	19	5
D03	Different customs in the project host country and China.	19	4
D04	Different laws and regulations in the project host country and China.	14	3
D05	Different standards and practices in the project host country and China.	14	0
D06	Shortage of materials in the project host country.	4	3
D07	Limited logistic support from home office.	8	3
D08	High turnover rates of frontline workers.	2	1
D09	Labor-only subcontracting and complex labor structure.	4	2
D10	Difficulty in changing weak safety awareness of local workers.	8	4
D11	Chinese workers are far from home and cannot adapt boring lifestyle in overseas projects.	4	2
D12	Tough projects (e.g. complex design, tight schedule).	19	1
D13	Different safety management concepts between the developer and the main contractor.	5	3
D14	Different safety management concepts between the main contractor and the subcontractors.	6	4
D15	Language barriers among project participants.	7	6
D16	Cultural Differences among project participants.	9	0

Difference in socio-economic development in the project host country and China

The countries where the projects are located are mainly less developed countries with poor facilities in local transportation, health care, and other aspects. The majority of local employees are uneducated with low technical merit, competence, quality, and safety awareness. All the above factors cause the content of safety management wider and more complex and increase the cost of management and difficulty.

Difference in geographical climate in the project host country and China

The climate in the countries of some overseas projects differs from that in China. Weather conditions are sometimes harsh and extreme, which are not advantageous to safety management. For example, some of the countries feature tropical monsoon climate, which is both hot and rainy, thereby resulting in increased frequency of accidents. During summer, mosquito bites and infectious diseases seriously affect the safety of workers and the progress of projects. Interviewee C remarked, “As the weather here is quite hot, many local workers prefer to wear shorts and T-shirts on site, and many of them even do not wear shoes at all. We exerted considerable efforts to change this problem, and we even give them free shoes. However, many local workers walk barefoot on site because they find it more comfortable than wearing shoes. Many local workers also do not wear personal protective equipment to enable them to work comfortably.”

Tight budget, tight schedule, and long construction period in the overseas projects of CICs

Tight budget, tight schedule, and long construction period in the overseas projects of CICs are difficult to avoid. Lack of safety investment is the most common issue in overseas project safety management. Many Chinese enterprises win bids with low prices thereby leading to the tight budget of contractors and subcontractors. This situation results in insufficient investment in safety. Moreover, contractors cannot easily claim damages because of delay in the project period. These delays cause a series of disasters that result in reduced safety investment. Overseas projects generally have harsh contract conditions in punishment of delay, which exert huge pressure on contractors. These conditions often lead to ignorance of safety management. Thus, workers often prolong working time and work overtime. Thus, they are likely to work in stressful conditions and operate machines in bad conditions without ensuring safety and quality measures. These practices could lead to accidents. The long period of overseas projects tends to weaken the safety awareness of site personnel. Site management personnel work in foreign countries for a long time, which can easily subject them to physical fatigue, anxiety, boredom, and decreased attention. These conditions could easily lead to accidents.

Language barriers among project participants

Language barriers pose serious challenges to the management of construction safety in the overseas projects of CICs. Language barriers may cause miscommunication in five aspects: 1) cannot understand an oral instruction; 2) cannot ask a question about the work; 3) cannot engage in a discussion about the work; 4) cannot read the manual; and 5) cannot fill in a form (Paul, 2013). These miscommunications also happen in CICs' overseas projects, leading to dangerous situations and resulting in accidents. English as an international language is commonly used for communication in international projects. Many Chinese employees, especially those working on site, including foremen and frontline workers, have inadequate English skills (Zhao and Shen, 2008). Local workers may not fully understand some of the safety measures because of language barriers, which could result in the failure of safety measures to achieve desired results. Language barriers are generally difficult to overcome. Frontline workers rely on their native language to communicate on construction site. Such behaviors create linguistic ghettos which hinder integration and development of ability for a second language (Jaselskis et al., 2008). Although there are several measures to overcome language barriers on construction site, the implementation of them needs significant amount of input. The enterprises would consider cost benefit analysis and return on investment in their specific situation.

Difficulty in changing weak safety awareness of local workers

Safety awareness of local workers is difficult to change in CICs' overseas projects. As Interviewee H remarked, "Because the local workers never worked in the construction industry before, their safety awareness is very low. Actually, they even do not know where is dangerous at the beginning." In addition to the inexperience of local workers, particular traditions and customs may also lead local workers to endure suffering and view dangers as unavoidable for survival. Safety awareness is a complicated occurrence that could be influenced by psychological, physical, social, political, and cultural factors (Kouabenan, 2009). Interviewee G remarked, "They disobey the safety regulations which add safety hazards on site. We have made many efforts on protection; however, there are always local workers injured due to going to unprotected areas." Although safety awareness of workers could probably be changed through safety training and education (Hon et al., 2012), the high turnover rate of frontline workers in CICs' overseas projects bring challenges in providing safety training and education to them.

4.3.2 Relative importance of the identified difficulties

Statistical data analysis was conducted on two rounds of the Delphi survey. Mean ratings and rankings are shown in Tables 4.6 and 4.7. After conducting the survey, the panel identified the top four difficulties encountered when implementing safety practices in the overseas projects of CICs. These difficulties were labor-only subcontracting and complex labor structure, difficulty in changing weak safety awareness of local workers, high turnover rates of frontline workers, and inability of Chinese workers who work far from home to adapt to a boring lifestyle in overseas projects.

Tables 4.6 and 4.7 show that the Kendall's W values of all experts in the two rounds were 0.161 and 0.197, respectively. Significant consensus among all experts was confirmed. W values increased in a sequential round of Delphi survey. The chi-square values in the two rounds were 62.730 and 76.831, which were both statistically significant. The two-round Delphi survey successfully improved agreement among all experts and the reliability of results. Although W value of the Southeast Asia group could not reach significant level in the first round of survey, significant consensus was confirmed in the second round. The Kendall's W value of the Southeast Asia group was 0.211 in the second round of survey. Rating agreement was improved within the Africa group at significant level. The Kendall's W value of the Africa group increased from 0.291 in the first round to 0.354 in the second round. However, the W value at significant level of the Middle East group slightly decreased from 0.338 in the first round to 0.332 in the second round. The Kendall's W values for the others group were not significant in two rounds of survey. The Wilcoxon signed-rank test was used to compare the repeated measurements in two rounds of Delphi survey. Table 4.8 shows that all 16 items were insignificant, which indicates that lack of significant difference between the ranks of experts of items in the two rounds.

Table 4.6 Results of round one Delphi survey: Difficulties in implementing safety practices in CICs' overseas projects

Items	All experts		Southeast Asia		The Middle East		Africa		Others		Kruskal-Wallis test
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Asymp. sig.
D01	2.85	11	3.38	8	2.71	14	2.75	8	2.00	16	.270
D02	2.85	12	3.25	11	3.57	3	2.13	15	2.00	15	.051
D03	2.77	13	3.13	12	2.71	12	2.50	11	2.67	8	.675
D04	2.92	9	2.75	16	2.86	11	3.13	5	3.00	6	.681
D05	2.92	10	3.13	14	3.14	8	2.50	12	3.00	5	.601
D06	2.62	14	2.88	15	2.00	15	3.00	6	2.33	14	.260
D07	2.58	15	3.25	9	2.00	16	2.38	13	2.67	9	.143
D08	3.27	4	3.50	4	2.71	13	3.50	2	3.33	3	.688
D09	3.85	1	4.13	1	4.14	1	3.50	3	3.33	4	.467
D10	3.73	2	4.00	2	3.29	6	3.75	1	4.00	1	.694
D11	3.31	3	3.50	5	3.57	4	3.25	4	2.33	12	.421
D12	2.58	16	3.13	13	2.86	10	1.88	16	2.33	13	.053
D13	3.15	6	3.38	7	3.71	2	2.63	9	2.67	7	.156
D14	3.19	5	3.50	3	3.14	7	2.88	7	3.33	2	.599
D15	3.04	7	3.50	6	3.43	5	2.38	14	2.67	10	.061
D16	2.96	8	3.25	10	3.14	9	2.63	10	2.67	11	.533
Number	26		8		7		8		3		
Kendall's W	.161		.193		.338		.291		.493		
Chi-Square	62.730		23.214		35.456		34.871		22.196		
Asymp. Sig.	.000		.080		.002		.003		.103		

Table 4.7 Results of round two Delphi survey: Difficulties in implementing safety practices in CICs' overseas projects

Items	All experts		Southeast Asia		The Middle East		Africa		Others		Kruskal-Wallis test
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Asymp. sig.
D01	2.92	8	3.25	8	3.00	12	2.75	4	2.33	13	0.551
D02	2.85	12	3.13	11	3.71	2	2.13	15	2.00	16	0.017
D03	2.92	8	3.13	11	3.14	8	2.50	9	3.00	4	0.551
D04	2.88	11	2.88	15	3.00	12	2.75	4	3.00	4	0.968
D05	2.85	12	3.13	11	3.14	8	2.38	12	2.67	7	0.225
D06	2.46	16	2.88	15	1.86	16	2.63	8	2.33	13	0.277
D07	2.65	15	3.25	8	2.29	15	2.50	9	2.33	13	0.110
D08	3.38	3	3.63	3	3.14	8	3.63	3	2.67	7	0.610
D09	3.92	1	4.00	1	4.00	1	4.00	1	3.33	2	0.774
D10	3.73	2	4.00	1	3.43	5	3.75	2	3.67	1	0.764
D11	3.19	4	3.38	6	3.71	2	2.75	4	2.67	7	0.177
D12	2.69	14	3.25	8	2.86	14	2.00	16	2.67	7	0.051
D13	3.08	6	3.50	5	3.57	4	2.38	12	2.67	7	0.012
D14	3.15	5	3.63	3	3.29	6	2.50	9	3.33	2	0.048
D15	2.92	8	3.38	6	3.29	6	2.25	14	2.67	7	0.032
D16	3.00	7	3.13	11	3.14	8	2.75	4	3.00	4	0.842
Number	26		8		7		8		3		
Kendall's W	.197		.211		.332		.354		.472		
Chi-Square	76.831		25.342		34.885		42.512		21.225		
Asymp. Sig.	.000		.046		.003		.000		.130		

Table 4.8 Wilcoxon Signed-Rank test of two rounds Delphi surveys: Difficulties of implementing safety practices in CICs' overseas projects

Items	Wilcoxon Signed-Rank test	
	Z-value	Asymp. Sig.
D01	-0.816	0.414
D02	0.000	1.000
D03	-1.414	0.157
D04	-0.333	0.739
D05	-0.632	0.527
D06	-1.265	0.206
D07	-0.816	0.414
D08	-0.791	0.429
D09	-0.707	0.480
D10	0.000	1.000
D11	-1.000	0.317
D12	-1.732	0.083
D13	-0.333	0.739
D14	0.000	1.000
D15	-1.342	0.180
D16	-0.447	0.655

4.3.3 Agreement of experts from different regions

The Kruskal-Wallis test was used to compare the opinions of experts among various region groups. Insignificant result indicates that agreement is achieved among different region groups. As shown in Table 4.6, the Kruskal-Wallis test did not confirm any significant item in the first round. Inter-group comparison indicates that even though the experts work in different regions, they have similar opinion toward the difficulties of implementing safety practices on many items. In other words, the identified difficulties of implementing safety practices in the overseas projects of CICs are generally recognized across regions. However, in the second round, four items, namely, D02, D13, D14, D15, were tested as significant

(Table 4.7). This finding indicates that agreement among different region groups could not be achieved for these four items. The Mann-Whitney U test was conducted for pairwise comparison among four groups. As shown in Table 4.9, the test between Southeast Asia group and Africa group, as well as the test between the Middle East group and Africa group, were significant. This finding suggests disagreement of opinions between experts from Southeast Asia and Africa and disagreement of opinions between experts from the Middle East and Africa.

The Middle East group ranked "different geographical climate in the project host country and China" as the second most important difficulty, whereas all the other three groups ranked this item after 10th. This finding may be attributed to harsh climate, such as torrid desert climate in some Middle Eastern countries. Given the unfamiliar environment and harsh climate, workers may suffer from severe physical and mental fatigue, which increases their safety risks. The Africa group ranked "different safety management concepts between the developer and the main contractor" and "different safety management concepts between the main contractor and the subcontractors" as 12th and ninth respectively, whereas other three groups ranked them as seventh or sixth. The Africa group also ranked "language barriers among project participants" as 14th, whereas the other three groups ranked it as eighth. Findings related to these three items are unexpected. This result may be attributed to the fact that the main contractors have prepared themselves to face the difficulties before they become obstacles. For example, in Southeast Asia and Middle Eastern countries, English is used as working language in many international projects. Given that most of the management staff could speak a bit of English, few translators were employed on site. In Africa, some project host countries use French, Spanish, and Portuguese as official languages.

Thus, translators were often used in these projects. Difficulties might be significantly alleviated by adopted appropriate measures.

Table 4.9 Results of Mann-Whitney U test for the Kruskal-Wallis test significant items

Items	Southeast Asia vs. The Middle East	Southeast Asia vs. Africa	Southeast Asia vs. Others	The Middle East vs. Africa	The Middle East vs. Others	Africa vs. Others
D2	.174	.055	.130	.009**	.032	.914
D13	1.000	.013*	.099	.006**	.059	.567
D14	.418	.015*	.510	.046*	1.000	.067
D15	.800	.013*	.152	.024*	.216	.367

4.3.4 Discussions

Discrepancies exist between the qualitative and quantitative findings. The difficulties identified in the documents and interviewees were not the most important difficulties ranked by the 26 experts. This discrepancy could be attributed to the fact that the most mentioned items from the qualitative data are generally macro level factors, which are easy to recognize and describe. Micro level factors are the difficulties that produce on-site effects. These difficulties are also confronted daily by participants. These important micro level obstacles are discussed as follows.

CICs face difficulties in implementing safety practices because of labor-only subcontracting and complex labor structure. A key issue concerning safety control for main contractors is the extension of their control over subcontractors (Niskanen, 1994). Negative consequences of labor subcontracting on safety was confirmed in previous studies (Ofori and Debrah, 1998). Workers from labor subcontractors may encounter difficulty in obtaining sufficient safety training opportunities on site because they are not directly employed.

The low safety awareness of local workers also creates obstacles in managing construction safety. Safety awareness is one's attitude to hazards and possibility of personal injury in the workplace (Williamson et al., 1997). According to expert opinion, local workers of project host countries are generally less safety-aware and cautious than Chinese workers. Local workers do not have the same degree of safety awareness because they are not used to the safety practices of CICs. The management is incumbent to improve the safety awareness of workers throughout their organization. Safety training of supervisors and frontline workers can effectively improve the safety awareness of workers on site (Choudhry and Fang, 2008; Fung et al., 2005). Safety promotion strategies, which include mission statements (e.g., slogans and logos), published materials (e.g., library, statistics, newsletters), and media (e.g., posters, displays, audiovisual, e-mail, internet) can be used to raise the safety awareness of workers (Choudhry et al., 2007b).

Another important obstacle in implementing safety practices is the high turnover rates of frontline workers. Unsteady human resource provision is common in construction projects. The high turnover rate of frontline workers is harmful to safety management, because it reduces the improvement of workers' skill and disturbs their learning curves (Han et al., 2008). Workers who work repeatedly for one contactor tend to develop awareness (Chen et al., 2012), whereas workers on a short tenure of employment are vulnerable to accidents (Debrah and Ofori, 2001). During the progress of project localization, many non-Chinese workers are substituted for Chinese ones, which lead to relatively high turnover rate and adverse effect to safety management.

Maladjustment of workers is another difficulty in construction safety. Chinese workers are far from home and cannot adapt to a boring lifestyle in overseas projects. Fatigue covers physical, mental, and emotional aspects (Chan, 2011). Hinze's theory of distraction and Suraji's theory of constraints-response indicate that one's mental state and emotional distress, especially miserable factors, could distract workers from the hazards, thereby increasing the likelihood of accidents (Hinze, 1997; Suraji et al., 2001). According to statistics, more than half a million of Chinese workers worked in overseas contracted projects in 2014 (National Bureau of Statistics, 2015). Majority of these workers shoulder the responsibility of supporting their families. Thus, they prefer to work overtime to earn more money. In addition, their boring life overseas aggravates the workers' exhausted spirits, which affect their safety performance.

Language barriers are also important in international construction projects. Frontline workers usually depend on their native language for on-site communication (Trajkovski and Loosemore, 2006). Communication efficiency about issues related to health and safety is significantly reduced between groups that speak different languages. Mandatory safety training in the workers' mother tongue with translated print material should be provided. A series of complementary schemes could be developed to overcome language barriers. These schemes could include translation of safety signage, labeling of equipment manuals and hazardous materials, and use of signage based on images rather than words.

4.4 CHAPTER SUMMARY

This chapter presents the findings of document analysis and structured interview in the identification of problems for managing construction safety and difficulties of implementing safety practices in CICs' overseas projects. The two-round Delphi survey results regarding the relative importance of the identified problems and difficulties are also stated in this chapter. The five most important problems of safety management in the overseas projects of CICs are: 1) weak safety awareness of local workers; 2) low safety management ability of local subcontractors; 3) inadequate safety budget; 4) mental and physical fatigue of Chinese workers; and 5) unclear responsibility for construction safety in CICs' overseas projects. The four most important difficulties of implementing safety practices in the overseas projects of CICs are: 1) labor-only subcontracting and complex labor structure; 2) difficulty in changing weak safety awareness of local workers; 3) high turnover rates of frontline workers; and 4) inability of Chinese workers who work far from home to adapt to a boring lifestyle in overseas projects. The agreement of experts from different regions on these items is analyzed and discussed.

CHAPTER 5 SAFETY CLIMATE AND SAFETY PERFORMANCE IN CICS' OVERSEAS PROJECTS[1]

5.1 INTRODUCTION

Table 5.1 Abbreviation list in this chapter

Abbreviation	Term
EFA	Exploratory factor analysis
CFA	Confirmatory factor analysis
KMO	Kaiser-Mayer-Olkin
PCA	Principal component analysis
TMC	Top management commitment
CCC	Coworkers' caring and communication
CRM	Coworkers' role models
SE	Supervisors' expectation
FRTO	Factor related to organization
FRTS	Factor related to supervisors
FRTC	Factor related to coworkers
SEM	Structural equation modeling
AVE	Average variance extracted
CR	Construct reliability
χ^2/df	The ratio of model chi-square to the degrees of freedom
GFI	Goodness-of-fit
AGFI	Adjusted goodness-of-fit
RMSEA	Root mean square error of approximation
TLI	Tucker-Lewis index
CFI	Comparative fit index

This chapter presents the research findings to achieve Objectives 2 and 3. The factor structure of safety climate in CICs' overseas projects is identified by EFA and verified by CFA. The relationship between safety climate and safety performance in CICs' overseas projects are hypothesized and empirically tested.

[1] Major part of this chapter has been published in the following paper:
Gao, R.*, Chan, A. P. C., Utama, W. P., and Zahoor, H. (2016). Multilevel safety climate and safety performance in the construction industry: development and validation of a top-down mechanism. *International journal of environmental research and public health*, *13*(11), 1100.

As a lot of abbreviations are used in this chapter, an abbreviation list has been provided for the readers to read and understand more easily (Table 5.1).

5.2 DESCRIPTIVE STATISTICS

From the questionnaire survey, a total of 1490 questionnaires were distributed; 1120 completed questionnaires were returned for a response rate of 75.2%. After deleting the extreme and missing values, 1030 questionnaires were used for analysis. Overall, approximately 20.4% of the participants were Chinese while the others were Vietnamese (79.6%), 26.4% had religious belief, and 8.5% were directly employed by the main contractor. Approximately 83.7% of the participants were male and 71.0% were married. The largest group among the participants in terms of age was individuals from 21 to 30 years old (62.2%), while the most common number of family members supported was two (26.0%). Most of the participants had a junior middle school level (31.4%). The range of 1 to 5 years was generally common (64.0%) for the participants' job tenure. Approximately 39.0% of the participants had a smoking habit, while 42.5% had a drinking habit. Table 5.2 shows the details of the participants' personal particulars. The Cronbach's alpha coefficient was 0.917 for the entire safety climate scale, which is at an acceptable level. The Cronbach's alpha coefficient was 0.831 for the safety performance scale, which is also acceptable.

The mean and standard deviation of safety climate were 3.91 and 0.31, respectively, indicating that the entire safety climate falls between "neutral" and "agreement". Zhou et al. (2010) previously measured the safety climate of the domestic projects undertaken by a Chinese construction company, which was listed among the Engineering News-Record top 225 international contractors. However, because the safety climate structures and measurement tools are different between the two studies, it is difficult to compare safety climate in overseas and domestic projects (Zhou et al., 2010). Some industrial practitioners have indicated that the overseas safety management capacity of CICs is relatively weak as compared to their safety management in domestic projects (He, 2014). CICs often win their overseas projects with relatively low bidding prices (Lu et al., 2009), and projects with competitive biddings tend to neglect safety management (Holmes et al., 2000). This echoes with the qualitative findings of the current study. The direct consequence of low bidding prices might be inadequate safety budget. Inadequate safety budget is the most frequent problem identified from document analysis, which is ranked top three during the Delphi survey.

Table 5.2 Personal particulars of the participants

Demographic variables	N (%)	Demographic variables	N (%)
Age		*Smoking habit*	
20 or below	16 (1.6%)	I don't smoke	628 (61.0%)
21 to 30	641 (62.2%)	I smoke but not at work	376 (36.5%)
31 to 40	283 (27.5%)	I smoke even at work	26 (2.5%)
41 to 50	80 (7.8%)	*Drinking habit*	
51 or above	10 (1.0%)	I don't drink	592 (57.5%)
Gender		I drink but not at work	432 (41.9%)
Male	862 (83.7%)	I drink even at work	6 (0.6%)
Female	168 (16.3%)	*Job tenure*	
Marital status		< 1 year	142 (13.8%)
Single	299 (29.0%)	1-5 years	659 (64.0%)
Married	731 (71.0%)	6-10 years	138 (13.4%)
Number of family members supported		11-20 years	79 (7.7%)
0	45 (4.4%)	> 20 years	12 (1.2%)
1	127 (12.3%)	*Nationality*	
2	268 (26.0%)	Chinese	210 (20.4%)
3	231 (22.4%)	Vietnamese	820 (79.6%)
4	237 (23.0%)	*Religious belief*	
5	74 (7.2%)	No	758 (73.6%)
6	44 (4.3%)	Yes	272 (26.4%)
7 or above	4 (0.4%)	*Employment mode*	
Education level		Directly employed	88 (8.5%)
Below primary	44 (4.3%)	Subcontractor	942 (91.5%)
Primary	179 (17.4%)		
Junior middle school	323 (31.4%)		
High school	296 (28.7%)		
College	108 (10.5%)		
Bachelor or above	80 (7.8%)		

5.3 EXPLORATORY FACTOR ANALYSIS AND CONFIRMATORY FACTOR ANALYSIS

5.3.1 Exploratory factor analysis

Nearly half of the data were used to conduct EFA in the SPSS for Windows 17.0 software package. The EFA results on safety climate showed that the KMO measure of sampling accuracy was 0.891 and Barlett's test of sphericity was significant ($p < 0.001$), indicating that the data were appropriate for factor analysis (Kaiser, 1974). The 38 safety climate items were subjected to a factor analysis with PCA extraction and Oblimin rotation method. This analysis yielded an interpretable result of four factors using the parallel analysis and explained 56.93% of variance. They explained 23.19%, 16.09%, 10.84%, and 6.81% of variance, respectively. The final result included 27 items with factor loadings above 0.50 on one of the four factors (Table 5.3). The factor loadings of each item and the percentage of variance explained by each factor are also shown in Table 5.3. The first factor was interpreted as top management commitment (TMC), which consisted of 10 items, indicating the attitude toward safety of top management level in the organization. The second factor was explained as coworkers' caring and communication (CCC), and it included eight items reflecting coworkers' opinion on communicating with other workers and their will to help other workers. The third factor was explained as coworkers' role models (CRM) because it comprised four items indicating coworkers' safety behaviors that could provide a fine example to other workers. The fourth factor was interpreted as supervisors' expectation (SE), and it consisted of five items focusing on supervisors' attitude toward construction safety. All the factors included more than four items, and the

Cronbach's alpha coefficients for TMC, CCC, CRM, and SE were 0.961, 0.887, 0.897, and 0.890 respectively, which were all above 0.70 and considered acceptable (Litwin, 1995; Zhou et al., 2010). TMC and SE were identified as factors related to organization and supervisors, respectively, whereas CCC and CRM were identified as factors related to the coworkers.

Table 5.3 Exploratory factor analysis of safety climate

Construct	Code	Factor loading	Cronbach's alpha	Variance explained (%)
TMC	SC02	0.886	0.961	23.19
	SC01	0.873		
	SC06	0.872		
	SC15	0.866		
	SC12	0.853		
	SC07	0.852		
	SC16	0.850		
	SC03	0.846		
	SC08	0.809		
	SC05	0.807		
CCC	SC36	0.795	0.887	16.09
	SC37	0.780		
	SC32	0.749		
	SC33	0.745		
	SC35	0.745		
	SC30	0.728		
	SC31	0.726		
	SC29	0.662		
CRM	SC34	0.834	0.897	10.84
	SC28	0.830		
	SC38	0.814		
	SC27	0.699		
SE	SC25	0.874	0.890	6.81
	SC26	0.869		
	SC22	0.799		
	SC24	0.786		
	SC23	0.701		

The EFA results on safety performance indicated that the KMO measure of sampling accuracy was 0.860 and Barlett's test of sphericity was significant ($p < 0.001$). The safety performance items were also subjected to a factor analysis with PCA extraction and Oblimin rotation method. This analysis yielded an interpretable result of one factor and explained 56.04% of variance. The final result included six items with factor loadings above 0.50 on this factor (Table 5.4).

Table 5.4 Exploratory factor analysis of safety performance

Construct	Code	Factor loading	Variance explained (%)
Safety performance	SPart.1	0.777	56.04
	SComp.3	0.777	
	SComp.2	0.759	
	SComp.1	0.758	
	SPart.3	0.743	
	SPart.2	0.673	

5.3.2 Confirmatory factor analysis

A proposed measurement model composed of TMC, SE, CCC, CRM, and safety performance was examined. The remaining half of the data was submitted to the AMOS version 17.0 for CFA. Table 5.5 provides the empirically tested results of safety climate and safety performance measurement model with standardized parameter estimates. The analysis retained items with factor loadings larger than 0.50 (Hair, 2010). SC01, SC06, SC07, and SC15 were removed from the factor of TMC. SC33 and SC29 were removed from the factor of CCC, and SC27 was removed from the factor of CRM. SPart.2 and SPart.3 were removed from the factor of safety performance. The results showed that all values of CR for the four constructs were more than 0.70, signifying a satisfactory level of CR. All values of AVE were around or higher than 0.50, suggesting a satisfactory level of CR (Hair, 2010). According to Table 5.6, the selected model fit indices were all at the acceptable level for the measurement model (χ^2/df = 4.091, GFI = 0.879, AGFI = 0.849, RMSEA = 0.073, TLI = 0.898, and CFI = 0.911). All paths from the observed variables to the latent factors were significant.

Table 5.5 Measurement model evaluation

Construct	Code	Loading	AVE	Composite reliability
TMC	SC02	0.743	0.704	0.934
	SC03	0.873		
	SC05	0.863		
	SC08	0.868		
	SC12	0.845		
	SC16	0.836		
SE	SC22	0.651	0.635	0.895
	SC23	0.699		
	SC24	0.805		
	SC25	0.877		
	SC26	0.919		
CCC	SC30	0.696	0.504	0.859
	SC31	0.709		
	SC32	0.708		
	SC35	0.679		
	SC36	0.736		
	SC37	0.729		
CRM	SC28	0.793	0.525	0.766
	SC34	0.602		
	SC38	0.765		
Safety performance	SComp.1	0.677	0.492	0.794
	SComp.2	0.727		
	SComp.3	0.766		
	SPart.1	0.627		

Table 5.6 Goodness-of-fit indexes for measurement and structural models

Model	χ^2	χ^2/DF	GFI	AGFI	RMSEA	TLI	CFI
Measurement	989.918	4.091	0.879	0.849	0.073	0.898	0.911
Structural	1116.697	4.595	0.864	0.833	0.079	0.882	0.896

5.4 STRUCTURAL EQUATION MODELING

5.4.1 Hypothesized structural equation model

As discussed in Chapter 2, safety performance could be affected by safety climate. In this study, all identified factors related to organization (FRTOs), factors related to supervisors (FRTSs), and factors related to coworkers (FRTCs) of safety climate are proposed to have positive influences on safety performance. In construction projects, top management establishes organizational safety policies and procedures. Management commitment to safety, which involves top management's safety attitudes and practices, is important for creating a positive organizational safety culture (O'Dea and Flin, 2003). For this reason, it is supposed that FRTOs will have positive overall effects on other factors. In construction projects, most frontline workers have few opportunities to contact with top management. They are more likely to be affected by communications with members in their groups. Labors work in small groups and report to an appointed supervisor. Communication with supervisors represents to workers the real priority of safety, through the practices supervisors implement company safety regulations and resolve conflicts between safety and productivity (Sparer et al., 2013). Coworkers present information, provide care, and act as role models in the work environment. Their behaviors also influence workers' task performance (Brondino et al., 2012). Coworkers are closer and larger in number than managers and supervisors. Workers tend to develop clear safety beliefs through exchanges with coworkers. This model supposes sequent effects of FRTOs on safety performance, through FRTSs and FRTCs. The following five hypotheses were proposed in the current research and the proposed relationships among factors were shown in Figure 5.1.

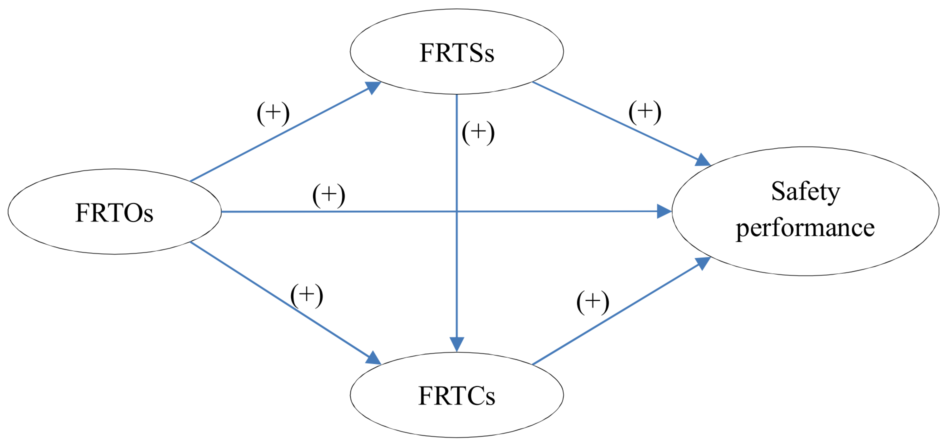


Figure 5.1 Research model and hypotheses

H1: FRTOs are positively related to FRTSs and FRTCs.

H2: FRTSs mediate the relationship between FRTOs and FRTCs.

H3: FRTSs mediate the relationship between FRTOs and safety performance.

H4: FRTCs mediate the relationship between FRTOs and safety performance.

H5: FRTCs mediate the relationship between FRTSs and safety performance.

As CCC and CRM are two separate FRTCs, the proposed research model in Figure 5.1 could be further developed as Figure 5.2.

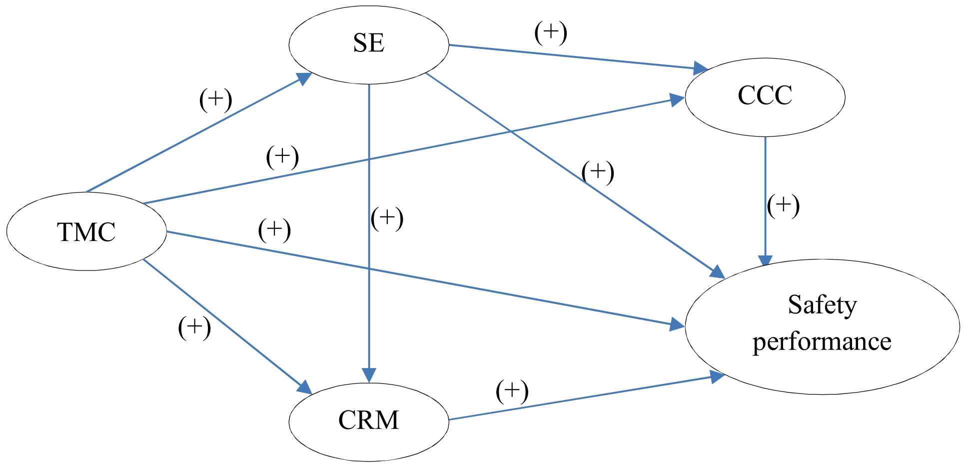
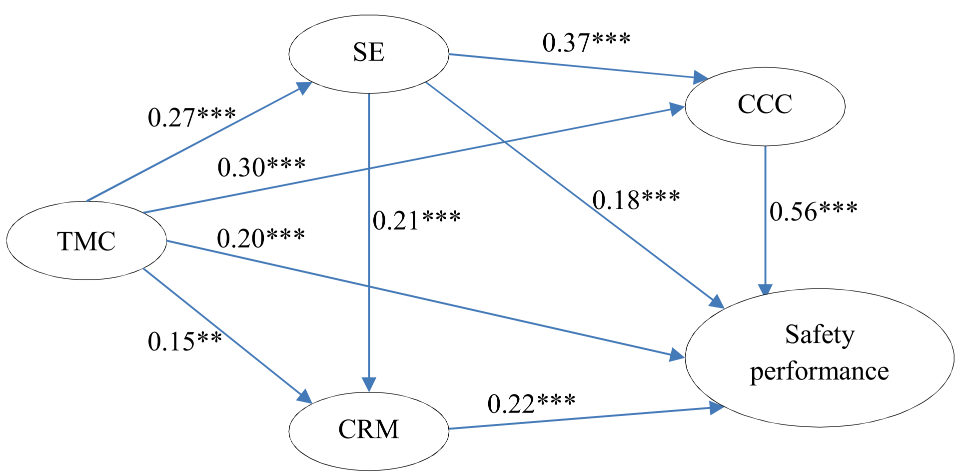


Figure 5.2 Further development of research model and hypotheses

5.4.2 Empirically tested structural equation model

Figure 5.3 presents the testing results of the structural model. Numbers on the arrows represent the path coefficients, which indicates the strength of the relationships among latent variables.



Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Figure 5.3 Testing results of the research model

According to Table 5.6, the model fit indices of the entire structural model were at acceptable level (χ^2/df = 4.595, GFI = 0.864, AGFI = 0.833, RMSEA = 0.079, TLI = 0.882, and CFI = 0.896).

H1: FRTO was confirmed positively related to the FRTS and FRTCs. H1 was supported. TMC had a strong statistically significant positive relationship with SE ($\beta = 0.27$, $p < 0.001$). TMC also had a significantly positive relationship with the two FRTCs: CCC ($\beta = 0.30$, $p < 0.001$) and CRM ($\beta = 0.15$, $p < 0.01$).

H2: FRTS mediated the relationship between FRTO and FRTCs. H2 was supported. Table 5.7 provides the effect paths of FRTO on FRTCs, FRTO on safety performance, and FRTS on safety performance. The indirect effect of TMC on CCC (indirect effect = 0.083, $p < 0.001$) as well as on CRM was positive and significant (indirect effect = 0.042, $p < 0.001$). Given the significant direct effect of TMC on CCC (direct effect = 0.258, $p < 0.001$) and CRM (direct effect = 0.113, $p < 0.05$), partially mediated relationships between TMC and CCC and CRM were recognized.

H3: FRTS mediated the relationship between FRTO and safety performance. H3 was supported. The indirect effect of TMC on safety performance was positive and significant (indirect effect = 0.091, $p < 0.001$). Considering the significant direct effect of TMC on safety performance (direct effect = 0.325, $p < 0.001$), a partially mediated relationship between TMC and safety performance was recognized.

H4: FRTCs mediated the relationship between the FRTO and safety performance. H4 was supported. The indirect effects of TMC on safety performance via CCC (indirect effect = 0.243, $p < 0.001$) and CRM (indirect effect = 0.081, $p < 0.001$) were positive and significant. Given the significant direct effect of TMC on safety performance via CCC (direct effect = 0.184, $p < 0.001$) and CRM (direct effect = 0.328, $p < 0.001$), partially mediated relationships were evident between the FRTO and safety performance through FRTCs.

H5: FRTCs mediated the relationship between FRTS and safety performance. H5 was supported. The indirect effects of SE on safety performance via CCC (indirect effect = 0.268, $p < 0.001$) and CRM (indirect effect = 0.096, $p < 0.001$) were positive and significant. The significant direct effect of SE on safety performance via CCC (direct effect = 0.170, $p < 0.001$) and CRM (direct effect = 0.323, $p < 0.001$) indicates partially mediated relationship between FRTS and safety performance through FRTCs.

As hypothesized, FRTO (i.e., TMC) is positively related to FRTS (i.e., SE) and FRTCs (i.e., CCC and CRM) significantly. SE could partially mediate the relationship between TMC and CCC and CRM as well as that between TMC and safety performance. CCC and CRM play a statistically significant partial mediation role in the relationship between TMC and safety performance as well as that between SE and safety performance.

5.5 DISCUSSIONS

TMC to safety is crucial for enhancing safety management in construction projects (Choudhry et al., 2007a; Hon et al., 2013; Lingard et al., 2012). Management commitment creates a positive safety culture by considering safety as an integrated component of the production system from the top rather than an independent part of production (Zohar, 1980). TMC can be explained as resource and time allocation, site inspections and risk assessments, and participation in safety meetings by management (Choudhry et al., 2007b). Participation of top management in safety committees and empowerment of safety officers are deemed critical (Zohar, 1980). Top management should exert efforts to support safety actively and consistently. Workers tend to perceive the real attitude of the management and follow their example and actions accordingly. The management is thus incumbent in establishing a positive and practical safety standard for workers (Aksorn and Hadikusumo, 2008). In construction projects, top management should exert special efforts to overcome the hazardous environment and compensate for the physical and psychological distance between the headquarters and projects (Meliá et al., 2008).

SE mediates the relationship between TMC and safety performance. This result is similar to that of Zohar and Luria (2005). Safety policies, procedures, and regulations, which are formulated at organization level, provide strategic and tactical rules for safety management. Safety practices, which relates to the implementation of these policies, procedures, and regulations, are implemented at group level. Safety climate can be formed from both the policy actions of top management and the practical actions of frontline supervisors. By communicating with supervisors, workers can perceive the true priority of safety; workers judge their supervisors' attitude toward safety on the basis of how they handle conflicting demands between productivity and safety (Sparer et al., 2013). In construction projects, the site involves continuous changes and immediate actions, and subcontracting is common. The projects may be distant from headquarters, and the frontline workers can hardly see the top management. The temporary nature of construction projects, the characteristics of the construction procedure, and the physical distance from headquarters further reduce the direct effect of organizational factors on safety performance (Swuste et al., 2012). Safety climate on TMC can be formed through the practical attitudes and actions of site supervisors. Therefore, effective communication between site supervisors and frontline workers should be established for workers to understand company safety regulations easily and improve safety performance accordingly.

CCC and CRM partially mediate the relationship between TMC and safety performance, and the relationship between SE and safety performance. The mediation effect of CCC is relatively stronger than SE for the relationship between TMC and safety performance, and this result echoes the studies of Tucker et al. (2008) and Chiaburu and Harrison (2008). Coworker support can predict many employee performances better than leader support can (Chiaburu and Harrison, 2008; Tucker et al., 2008). CCC and CRM exert significant effects on ensuring workers' safety performance. Coworkers' attitudes and actions toward safety influence safety performance because they provide basis of the type of actions that are socially acceptable within a workgroup or organization. CCC and CRM mediate the relationship between SE and safety performance as well as TMC and safety performance for the following reasons. For SE, coworkers support supervisors to reduce pressure to communicate and access to resources as well as enhance supervisors' awareness of self-efficacy to engage in safety leadership (Conchie et al., 2013). For TMC, attitudes and actions toward safety may also originate from the workers' own perceptions of the top management's commitment to safety (Morrow et al., 2010). Creating a friendly relationship among coworkers is thus important. Apart from taking personal responsibility, workers should also be educated to promote a sense of responsibility for coworkers' safety and create a safe work environment. Workers should be supported to remind their coworkers of safety by caring, communicating, and acting as role models.

Table 5.7 Breakdown of effect paths

Effect paths	Total effect	Indirect effect	Direct effect	Type
Effect of FRTO on FRTCs				
TMC→SE→CCC	0.341*** [0.249, 0.440]	0.083*** [0.047, 0.128]	0.258*** [0.176, 0.354]	Partial mediation
TMC→SE→CRM	0.155*** [0.079, 0.229]	0.042*** [0.014, 0.079]	0.113* [0.031, 0.192]	Partial mediation
Effect of FRTO on Safety performance				
TMC→SE→Safety performance	0.416*** [0.328, 0.522]	0.091*** [0.055, 0.136]	0.325*** [0.244, 0.417]	Partial mediation
TMC→CCC→Safety performance	0.427*** [0.339, 0.529]	0.243*** [0.173, 0.337]	0.184*** [0.118, 0.257]	Partial mediation
TMC→CRM→Safety performance	0.409*** [0.319, 0.512]	0.081*** [0.042, 0.128]	0.328*** [0.249, 0.431]	Partial mediation
Effect of FRTS on Safety performance				
SE→CCC→Safety performance	0.438*** [0.336, 0.561]	0.268*** [0.188, 0.364]	0.170*** [0.089, 0.259]	Partial mediation
SE→CRM→Safety performance	0.419*** [0.317, 0.532]	0.096*** [0.050, 0.155]	0.323*** [0.234, 0.421]	Partial mediation

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

5.6 CHAPTER SUMMARY

The current chapter has identified the factor structure of the safety climate and explored the underlying mechanisms of the relationship between safety climate and safety performance in CICs' overseas projects. According to the EFA results, TMC and SE are identified as factors to represent FRTO and FRTS respectively, and CCC and CRM are identified as factors to denote FRTCs. After verifying these identified factors in an integrated model in SEM, all five proposed hypotheses are tested and supported. FRTO (TMC) is positively related to FRTS (SE) and FRTCs (CCC and CRM) significantly. FRTS (SE) could partially mediate the relationship between FRTO (TMC) and FRTCs (CCC and CRM), as well as the relationship between FRTO (TMC) and safety performance. FRTCs (CCC and CRM) play a statistically significant partial mediation role in the relationship between FRTO (TMC) and safety performance, and the relationship between FRTS (SE) and safety performance.

CHAPTER 6 IDENTIFYING CRITICAL FACTORS AFFECTING SAFETY CLIMATE IN CICS' OVERSEAS PROJECTS[2]

6.1 INTRODUCTION

This chapter reports the research findings relating to Objective 4. This study would like to test several specific factors that are particularly important to safety climate in an international construction context. Three factors including nationality, religious belief, and employment mode are obvious in this context. Therefore, they are verified in this chapter. Future research should consider additional factors to improve the research findings further.

6.2 DEVELOPMENT OF RESEARCH HYPOTHESES

Several research hypotheses have been developed in the current study based on Section 2.7.1 to Section 2.7.3.

6.2.1 Nationality

Hypothesis 1a: Nationality has a significant effect on TMC. Workers from high socioeconomic developed countries tend to have more positive TMC than their coworkers from low socioeconomic developed countries.

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[2] Major part of this chapter has been published in the following paper:
Gao, R.*, Chan, A. P. C., Utama, W. P., and Zahoor, H. (2016). Workers' perceptions of safety climate in international construction projects: effects of nationality, religious belief, and employment mode. *Journal of Construction Engineering and Management*, 04016117.

Hypothesis 1b: Nationality has a significant effect on SE. Workers from high socioeconomic developed countries tend to have more positive SE than their coworkers from low socioeconomic developed countries.

Hypothesis 1c: Nationality has a significant effect on CCC. Workers from high socioeconomic developed countries tend to have more positive CCC than their coworkers from low socioeconomic developed countries.

Hypothesis 1d: Nationality has a significant effect on CRM. Workers from high socioeconomic developed countries tend to have more positive CRM than their coworkers from low socioeconomic developed countries.

6.2.2 Religious belief

Hypothesis 2a: Religious belief has a significant effect on TMC. Workers with religious belief tend to have more positive TMC than those without such belief.

Hypothesis 2b: Religious belief has a significant effect on SE. Workers with religious belief tend to have more positive SE than those without such belief.

Hypothesis 2c: Religious belief has a significant effect on CCC. Workers with religious belief tend to have more positive CCC than those without such belief.

Hypothesis 2d: Religious belief has a significant effect on CRM. Workers with religious belief tend to have more positive CRM than those without such belief.

6.2.3 Employment mode

Hypothesis 3a: Employment mode has a significant effect on TMC. Directly employed workers tend to have more positive TMC than subcontracted employees.

Hypothesis 3b: Employment mode has a significant effect on SE. Directly employed workers tend to have more positive SE than subcontracted employees.

Hypothesis 3c: Employment mode has a significant effect on CCC. Directly employed workers tend to have more positive CCC than subcontracted employees.

Hypothesis 3d: Employment mode has a significant effect on CRM. Directly employed workers tend to have more positive CRM than subcontracted employees.

6.2.4 Control variables

Several other variables can influence workers' perceptions of safety climate in construction projects (Fang et al., 2006; Gillen et al., 2002; Gyekye and Salminen, 2009; Zhou et al., 2008). A positive relationship is identified between safety climate and workers' age, marital status, number of family members supported, and education level (Fang et al., 2006; Gyekye and Salminen, 2009; Zhou et al., 2008); as well as a negative relationship is noted between drinking habit and safety climate (Fang et al., 2006). However, in the current research, no hypothesis is developed for them; instead, they are used as control variables. The control variables included in the current study are age (five categories: 1 = 20 or below, 2 = 21 to 30, 3 = 31 to 40, 4 = 41 to 50, and 5 = 51 or above), gender (female = 1 and male = 0), marital status (married = 1 and single = 0), number of family members supported (eight categories: 1 = 0, 2 = 1, 3 = 2, 4 = 3, 5 = 4, 6 = 5, 7= 6, and 8 = 7 or above), education level (six categories: 1 = below primary, 2 = primary, 3 = junior middle school, 4 = high school, 5 = college, and 6 = bachelor or above), smoking habit (three categories: 1 = I don't smoke, 2 = I smoke but not at work, and 3 = I smoke even at work), drinking habit (three categories: 1 = I don't drink, 2 = I drink but not at work, and 3 = I drink even at work), and job tenure (five categories: 1 = below 1 year, 2 = 1-5 years, 3 = 6-10 years, 4 = 10-20 years, and 5 = over 20 years).

6.3 HIERARCHICAL LOGISTIC REGRESSION ANALYSIS

The correlation matrix was analyzed previously to conduct the hierarchical logistic regression analysis. Most of the correlations among the control and study variables were weak. In addition, the values of variance inflation factor (VIF) were all close to 1, and the maximum VIF value was only 1.666. The rule of thumb considers serious multicollinearity when the VIF value exceeds 10 (O'brien, 2007). Hence, concerns on multicollinearity problems were reduced accordingly. Table 6.1 shows the correlation matrix of the independent variables.

Tables 6.2, 6.3, 6.4, and 6.5 show the results of the hierarchical logistic regression analysis between the study variables and TMC, SE, CCC, CRM, respectively. All four models were significantly reliable ($\chi^2 = 671.185$, $p < 0.001$; $\chi^2 = 108.357$, $p < 0.001$; $\chi^2 = 102.905$, $p < 0.001$; $\chi^2 = 85.200$, $p < 0.001$). Table 6.2 shows that Cox and Sneel R^2 and Nagelkerke R^2 in Step 1 indicated that the model accounted for 31.9% to 42.6% of the variance in TMC. After adding three study variables, the model in Step 2 could finally reach 47.9% to 64.0% of the variance, indicating an improvement of the model. The other three models have a rather similar situation.

All of the models could be further improved by adding the three study variables, namely, nationality, religious belief, and employment mode.

Hypothesis 1a addressed the relationship between nationality and TMC. Table 6.2 shows a significant relationship between nationality and TMC after controlling for eight demographic variables. Chinese workers tended to have more positive TMC than Vietnamese workers in this study ($B = -4.023$; $p < 0.001$). Thus, Hypothesis 1a was completely supported. Significant relationship was also determined between nationality and SE ($B = 0.423$; $p < 0.05$) although the coefficient direction is opposite (Table 6.3). Chinese workers tended to have more negative SE than Vietnamese workers. Therefore, Hypotheses 1b was not supported. Hypothesis 1c addressed the relationship between nationality and CCC. Hypothesis 1d addressed the relationship between nationality and CRM. These two hypotheses were tested to be not significant and the coefficient directions were opposite ($B = 0.376$; $p = 0.081$; $B = 0.036$; $p = 0.869$). Thus, Hypothesis 1c and Hypothesis 1d were not supported.

Hypothesis 2a addressed the relationship between religious belief and TMC. Table 6.2 shows a significant relationship between religious belief and TMC after controlling for eight demographic variables; the coefficient direction was opposite with the Hypothesis 2a ($B = -1.501$; $p < 0.001$). Thus, Hypothesis 2a was not supported. According to Table 6.3, no significant relationship was determined between religious belief and SE ($B = -0.097$; $p = 0.562$), and the coefficient direction in this test was not matching either. Therefore, Hypotheses 2b was not supported. Table 6.4 shows that a significant relationship was identified between religious belief and CCC with the same coefficient direction ($B = 0.328$; $p < 0.05$), which fully supported Hypothesis 2c. Table 6.5 also shows that a significant relationship was identified between religious belief and CRM with the same coefficient direction ($B = 0.497$; $p < 0.01$), which completely supported Hypothesis 2d.

In terms of the relationship between employment mode and safety climate factors, Table 6.2 shows a significant relationship between employment mode and TMC, and the coefficient direction is also matching ($B = -3.395$; $p < 0.001$). Thus, Hypothesis 3a was fully supported. Significant relationship was also determined between employment mode and SE ($B = 1.575$; $p < 0.001$) but the coefficient direction is opposite (Table 6.3), so Hypothesis 3b was not supported. No statistically significant relationship was noted between employment mode and CCC ($B = -0.219$; $p = 0.379$) and CRM ($B= 0.261$; $p = 0.336$). The coefficient direction was consistent with Hypothesis 3c and inverse to Hypothesis 3d. Thus, Hypothesis 3c was partially supported, whereas Hypothesis 3d was not supported.

Table 6.1 Correlation matrix of the independent variables

Variables	Collinearity Statistics		Correlation coefficients (Spearman's rho)										
	Tolerance	VIF	1	2	3	4	5	6	7	8	9	10	11
Age	0.600	1.666	1.000										
Gender	0.823	1.214	-0.066*	1.000									
Marital status	0.690	1.450	0.359**	-0.100**	1.000								
Number of family members supported	0.665	1.503	0.296**	-0.181**	0.451**	1.000							
Education level	0.645	1.550	0.276**	-0.134**	0.007	0.276**	1.000						
Smoking habit	0.635	1.574	0.126**	-0.285**	0.127**	0.085**	0.027	1.000					
Drinking habit	0.637	1.569	0.016	-0.308**	0.050	-0.054	-0.022	0.550**	1.000				
Job tenure	0.600	1.666	0.537**	-0.140**	0.242**	0.336**	0.357**	0.223**	0.131**	1.000			
Nationality	0.635	1.574	-0.384**	0.113**	-0.079*	-0.177**	-0.472**	-0.128**	-0.031	-0.395**	1.000		
Religious belief	0.829	1.206	-0.074*	0.028	0.136**	0.077*	-0.212**	0.232**	0.216**	-0.036	0.199**	1.000	
Employment mode	0.893	1.120	-0.044	-0.091**	0.111**	0.006	-0.145**	0.042	0.041	0.044	-0.129**	0.049	1.000

Note: * $p < 0.05$; ** $p < 0.01$

Table 6.2 Logistic regression analysis results of TMC on research and control variables

Independent variables	Step 1		Step 2	
	B	Wald	B	Wald
Step 1 - Control Variables				
Age	1.152	53.100***	0.783	19.884***
Gender	-0.605	7.722**	-0.529	4.093*
Marital status	-0.639	9.712**	-0.404	2.812
Number of family members supported	0.659	82.006***	1.003	109.963***
Education level	0.493	44.081***	-0.027	.076
Smoking habit	-0.548	10.234**	-0.687	9.838**
Drinking habit	-1.227	44.383***	-1.192	28.999***
Job tenure	-0.626	21.560***	-1.012	35.393***
Step 2 - Study Variables				
Nationality			-4.023	97.601***
Religious belief			-1.501	39.655***
Employment mode			-3.395	53.977***
χ^2	395.885***		671.185***	
Cox and Snell R Square	0.319		0.479	
Nagelkerke R Square	0.426		0.640	

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 6.3 Logistic regression analysis results of SE on research and control variables

Independent variables	Step 1		Step 2	
	B	Wald	B	Wald
Step 1 - Control Variables				
Age	-0.433	12.414***	-0.344	7.310**
Gender	-0.437	5.175*	-0.349	3.080
Marital status	0.140	0.670	0.049	0.080
Number of family members supported	-0.017	0.102	-0.013	0.052
Education level	0.084	1.986	0.190	7.432**
Smoking habit	-0.826	28.809***	-0.803	25.762***
Drinking habit	-0.158	0.966	-0.154	0.878
Job tenure	0.544	25.501***	0.525	22.723***
Step 2 - Study Variables				
Nationality			0.423	4.087*
Religious belief			-0.097	0.336
Employment mode			1.575	25.255***
χ^2	76.415***		108.357***	
Cox and Snell R Square	0.072		0.100	
Nagelkerke R Square	0.096		0.134	

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 6.4 Logistic regression analysis results of CCC on research and control variables

Independent variables	Step 1		Step 2	
	B	Wald	B	Wald
Step 1 - Control Variables				
Age	-0.106	0.739	-0.058	0.210
Gender	0.745	14.856***	0.677	11.799***
Marital status	-0.288	2.768	-0.311	3.100
Number of family members supported	-0.302	27.780***	-0.327	31.156***
Education level	0.020	0.108	0.078	1.326
Smoking habit	-0.196	1.693	-0.229	2.192
Drinking habit	0.366	5.121*	0.312	3.606
Job tenure	0.556	25.883***	0.617	29.273***
Step 2 - Study Variables				
Nationality			0.376	3.042
Religious belief			0.328	3.927*
Employment mode			-0.219	0.773
χ^2	93.201***		102.905***	
Cox and Snell R Square	0.087		0.095	
Nagelkerke R Square	0.117		0.129	

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 6.5 Logistic regression analysis results of CRM on research and control variables

Independent variables	Step 1		Step 2	
	B	Wald	B	Wald
Step 1 - Control Variables				
Age	0.053	0.177	0.097	0.564
Gender	0.076	0.136	0.019	0.008
Marital status	-0.129	0.507	-0.197	1.136
Number of family members supported	-0.380	39.387***	-0.404	42.654***
Education level	0.233	13.412***	0.284	15.308***
Smoking habit	-0.030	0.037	-0.099	0.390
Drinking habit	0.157	0.885	0.092	0.288
Job tenure	0.289	6.851**	0.296	6.827**
Step 2 - Study Variables				
Nationality			0.036	0.027
Religious belief			0.497	8.184**
Employment mode			0.261	0.926
χ^2	75.882***		85.200***	
Cox and Snell R Square	0.071		0.079	
Nagelkerke R Square	0.100		0.112	

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

6.4 DISCUSSIONS

Table 6.6 shows the research results for testing all the hypotheses.

Table 6.6 Testing results of the hypotheses

Hypothesis	Independent variables	Direction	Significance
TMC			
1a	Nationality	Yes	Yes
2a	Religious belief	No	Yes
3a	Employment mode	Yes	Yes
SE			
1b	Nationality	No	Yes
2b	Religious belief	No	No
3b	Employment mode	No	Yes
CCC			
1c	Nationality	No	No
2c	Religious belief	Yes	Yes
3c	Employment mode	Yes	No
CRM			
1d	Nationality	No	No
2d	Religious belief	Yes	Yes
3d	Employment mode	No	No

6.4.1 Effects of nationality on safety climate factors

For the two significant relationships, coefficient direction is consistent with Hypothesis 1a and opposite to Hypothesis 1b, indicating that Chinese workers tend to have more positive TMC and more negative SE than their Vietnamese coworkers. For the opposite result of Hypothesis 1b, a possible explanation might be that the Vietnamese workers constitute the majority among our samples, and they usually work in the groups with supervisors and coworkers from Vietnam, so they have less communication barrier with their supervisors. From the traditional point of view, workers' safety climate is often in proportion to the socioeconomic level of their original countries (Mahalingam and Levitt, 2007). Occupational health and safety are identified to be closely related to global competitiveness index (GCI) at national level (Hämäläinen, 2007). GCI is a specific overview of socio-economic status. According to the global competitiveness index rankings in 2015, China ranks 28 among 144 global economies. Meanwhile, Vietnam ranks 68, indicating that it has a relatively lower socioeconomic level compared to China (Schwab and Sala-i-Martin, 2015). Both the price of local labor and compensation standard for accidents are low. The inadequate valuation of life leads to low safety awareness and negative safety climate. Maslow's hierarchy of needs explains the relationship between low socioeconomic development and low safety climate well; workers only pursue safety or security needs after they have fulfilled their basic physiological needs (Mearns and Yule, 2009). In addition, factors included in the GCI such as ethical behavior, education, and training can obviously affect safety management (Hämäläinen, 2007). According to human development report 2013, the education index is 0.481 for China and 0.447 for Vietnam, indicating a relatively higher education level of Chinese than that of Vietnamese (Malik, 2013). In terms of national culture, China and Vietnam are rather close in the dimensions of power distance, individualism, and uncertainty avoidance. Thus, the effects of these three facets of national culture are not discussed in the current study. China tends to have an evidently higher score in the dimensions of masculinity and long-term orientation than Vietnam, indicating that femininity and short-term orientation can impede workers' safety climate. This finding is in conflict with the results of Mohamed et al. (2009). However, the national cultural dimensions should not be regarded as the only framework to affect safety climate. Although these dimensions have been proven to have significant relationships with occupational health and safety in several previous studies, they merely raise the sensibility of participants' different attitudes and behaviors (Starren et al., 2013). This study takes CICs in Vietnam as an example. When the results are applied to international projects in other nations, specific practices should also be considered besides the socioeconomic development level and national culture.

6.4.2 Effects of religious belief on safety climate factors

The coefficients B in the last two tests of the relationship between religious belief and safety climate factors are expected to have matching directions significantly to what were hypothesized based on the literature review. This indicates that workers with religious belief tend to have more positive CCC and CRM than those without such belief. Smallwood (2002) explained that the responsibility to provide a moral level of care to others is a common theme in most, if not all, of the world's major religions. This concept of care benefits the establishment of good safety climate within the group and organization. In addition, the principles of major religions cherish values more than economic benefits, which is a beneficial sign of positive safety climate (Smallwood, 2002).

A study on the relationship between personality and religiosity reveals that extraversion and psychoticism are negatively related to religiosity, whereas neuroticism is positively related to religiosity (Eysenck, 1998). Christian et al. (2009) studies on personality and safety, and explains that a significant relationship does not exist between extraversion and safety, as well as between psychoticism and safety. However, in another study on the relationship between personality and traffic accidents, extraversion is correlated positively with traffic accidents, whereas neuroticism is related negatively with traffic accidents (Lajunen, 2001). Thus, a person with high extraversion and low neuroticism, who has a small possibility to profess a religion, tends to perform badly in safety, which echoes the research results of the current study.

6.4.3 Effects of employment mode on safety climate factors

For the two significant relationships, coefficient direction is consistent with Hypothesis 3a and opposite to Hypothesis 3b, indicating that workers directly employed by the main contractor tend to have more positive TMC and more negative SE than those employed by subcontractors. Directly employed workers are supposed to possess better TMC than subcontracted employees because the former has received continuous safety training after enrollment, and they can perceive a continuous management commitment to safety from the top management. Subcontracted workers are usually employed temporarily and have insufficient safety training, so they perceive relatively weak management commitment to safety from the top management. For the opposite result of Hypothesis 3b, the explanation might be due to the following reasons. First, the main contractors in the investigated projects tend to directly employ considerably few workers because of the unstable nature of international projects. Discussion with the project management of the investigated projects revealed that directly employed workers were general laborers and were employed from the local market for temporary works requiring limited skills. This case explains their relatively negative perceived safety climate. Second, Chinese management staff members experience difficulties in efficiently communicating with their directly employed local workers because of communication barriers, particularly language barriers.

Workers from local labor subcontractors often have more related working experiences and know more about local safety regulations than those directly employed by the main contractor. Subcontracted employees can also communicate effectively with their compatriot supervisors. Therefore, if the main contractor generally uses local workforce, then subcontracting to local subcontractors can enhance the safety management level.

6.5 CHAPTER SUMMARY

The current chapter has presented research findings to achieve Objective 2. The hierarchical logistic regression analysis results indicate that nationality, religious belief, and employment mode can affect safety climate factors to some extent.

CHAPTER 7 STRATEGIES FOR IMPROVING CONSTRUCTION SAFETY IN CICS' OVERSEAS PROJECTS

7.1 INTRODUCTION

This chapter presents the qualitative research findings and practical implications from quantitative research findings to fulfil Objective 5, which recommends strategies for improving construction safety in CICs' overseas projects. These identified strategies are further validated in the two-round Delphi survey. The five most important strategies ranked by the experts are raising workers' safety awareness, providing safety training and education actively, ensuring safety budget, managing subcontractors' safety in-depth and comprehensively, and paying attention to design, technology and equipment safety.

7.2 STRATEGIES EXPLORED FROM THE RESEARCH

7.2.1 Strategies identified from qualitative data analysis

After conducting document analysis and structured interview, strategies for improving safety management in CICs' international construction projects were formulated. Table 7.1 shows the eight most frequently mentioned strategies for improving safety management in CICs' overseas projects in document analysis and structured interviews. Establish and implement perfect safety management system, provide safety training and education actively, and construct safety culture are the most frequent strategies that identified from document analysis. Establish and implement perfect safety management system, provide safety training and education actively, consider the local culture, customs and religious belief, and overcome language barriers to conduct effective safety communication on site are the most frequently mentioned strategies in the structured interview.

Table 7.1 Frequently mentioned strategies for improving safety management in CICs' overseas projects in document analysis and structured interviews

Strategies	Document analysis (n=50)	Structured interviews (n=8)
Deliver management commitment to safety and establish safety production responsibility system.	22	4
Establish and implement perfect safety management system.	47	8
Provide safety training and education actively.	39	7
Pay attention to design, technology and equipment safety.	24	4
Concern about workers' physical and mental state.	14	3
Construct safety culture.	29	2
Overcome language barriers and conduct effective safety communication on site.	12	6
Consider the local culture, customs and religious belief.	21	7

Establish and implement an effective safety management system

Management system is required to identify, control, and pursue continuous improvement in construction health and safety. International standards, such as ISO 14000 and OHSAS 18001, are recommended for developing a holistic safety management process to meet with the international, national, or regional safety requirements (Koehn and Datta, 2003). Safety management system in a particular overseas project should ensure to cohere the safety requirement of the main contractors with that of the owners and subcontractors, as well as unite them with local laws and regulations. The implementation scheme of the system should be established according to project specifications. Safety management system should not only be a documented form but also proper implementation, inspection, and correction (Bottani et al., 2009). Actual condition on site should be analysed, and general terms should be partially adjusted according to project characteristics to ensure that management staff can implement them easily, and workers can abide by them conveniently.

Provide safety training and education actively

Safety training and education significantly influences safety performance on construction sites (Hinze and Gambatese, 2003; Tam and Fung, 2011). Safety training courses in overseas projects, which include the introduction of the safety management system of enterprises, safety standards and requirements, local laws and regulations, knowledge of disease prevention, and cultural background in project host countries, should be specifically designed based on the characteristics of project host countries. Providing active safety training and education in CICs' overseas projects is important. Becoming acquainted with an organization culture, and acquiring skills and methods by new comers to become skilled labours in the construction industry takes time (DeJoy et al., 2004). Safety orientation, as well as the continuation of safety training and education, can be provided to frontline workers. The workers should give importance to safety training and regard safety campaigns as aimed at themselves.

Consider local culture, customs, and religious beliefs

People from different countries have different ways of thinking and live uniquely according to their cultural environment. They build a belief system through culture, which influences their interpretation of natural phenomena (Dake, 1992). Values stem from traditional religion, and extended family systems have significant influence on the attitudes of individuals regarding construction safety. Local culture, customs, and religious beliefs significantly influence safety attitudes and behaviours of both the management and workers in international construction projects. Some biased safety awareness, such as unrealistically positive self-evaluations, the illusion of control, unrealistic optimism, and the illusion of invulnerability, can have a negative impact on safety behaviours in construction projects (Kouabenan, 2009). In CICs' overseas projects, the management should value the safety of all workers, regardless of their nationalities and beliefs. Conversely, workers should be informed of their personal vulnerabilities and be trained to avoid safety hazards. The workers should be taught with right information to disregard limited and false viewpoints about construction safety.

Construct safety culture

Safety management is influenced by cultural factors that are unique to the organization, such as organizational culture, safety policy, and management attitudes (Kouabenan, 2009). A good safety culture, which can affect safety performance positively, depends on three factors: rules for managing hazards, attitudes toward safety, and reflexivity regarding safety practices (Pidgeon, 1991). Rules for managing hazards define what should be considered to be hazards and what should be done to control them. Attitudes toward safety are the individual and shared beliefs regarding safety. Reflexivity regarding safety practices is a learning process for the awareness about new safety hazards. Safety culture is more than safety regulations. All members should commit to safety based on trust and shared understanding. Every member in the organization should advocate safety rules and support other members (Kouabenan, 2009). CICs should construct positive safety culture in international construction projects. Although labour in project host countries might be abundant and low-cost, the management of CICs should not consider safety measures as expensive, time-consuming, and useless. Management commitment should be given to safety. The value of safety should be prioritized, rather than production or profit, which should be instilled in workers to establish good safety culture within projects.

Overcome language barriers to conduct effective safety communication on site

Good and orderly communication channels are the platform to efficient implementation of safety management among organizations. The correctness and smoothness of communication is important. To achieve this, communication barriers, such as language barriers, should be overcome. According to Paul (2013), measures for overcoming language barriers and improving safety communication on site include interpreting, translating, working with pictures, organizing work to minimize language barriers, and learning a second language. In CICs' overseas projects, safety plans in different languages should be noticed before commencing construction. Signboards, warning boards, and propaganda materials should be in multiple languages. Moreover, the orientation of new workers with appropriate translation is crucial. Continuous education should be further provided to prevent accidents and improve communication skills (Han et al., 2008). According to Interviewees E and F, language courses should also be provided to Chinese managerial staff for long-term development and localization plans in foreign countries to assist them in communicating smoothly with local frontline workers.

Moreover, local management staff who are accustomed to the languages and culture of host countries, as well as those who can respond to CICs' requirements, should unite Chinese managers and local workers and facilitate communication among project participants.

7.2.2 Strategies identified from quantitative data analysis

Strategies and safety climate factors

The research findings of Chapter 5 recommend that positive safety culture should be established both at organizational and group levels. Top management, supervisors, and coworkers should exert effort toward safety management. First, the top management should exert efforts to support safety actively and consistently. Second, effective communication between site supervisors and frontline workers should be established for workers to understand company safety regulations easily and improve safety performance accordingly. Third, workers should be educated to promote a sense of responsibility for the safety of their coworkers and create a safe work environment. They should be supported to remind their coworkers of safety by caring, communicating, and acting as role models.

Strategies and critical affecting factors to safety climate

The research findings of Chapter 6 recommend that project managers should pay more attention to safety management in international construction projects than in domestic projects, and keep their eyes open on factors that can influence safety climate. First of all, workers of different nationalities should not be discriminated and all of them are equal to get enhanced for safety awareness and safety knowledge. The project managers and safety staff in international construction projects should adopt diverse management practices to improve workers' perceptions of safety climate, especially those from less developed countries and regions. In addition, all workers should be respected regardless of their religious belief. In international construction projects, management commitment should be given to safety, and the value of safety first, rather than production first or profit first, should be instilled in workers for the establishment of good safety climate within the projects. Finally, unlike the negative impact of subcontracting in general projects, it is deemed to be beneficial for safety climate in international construction projects. Main contractors should implement human resource localization to alleviate culture conflict and communication barriers in international construction projects. They should also seek and maintain close cooperation with local subcontractors who have rich experience and good reputation for safety.

7.3 VALIDATION OF THE STRATEGIES

7.3.1 Delphi survey results

Strategies explored from both the qualitative and quantitative research are validated in the two-round Delphi survey (Table 7.2). In the first round of Delphi survey, all experts were asked to rate the importance of the proposed strategies for improving construction safety in overseas projects of CICs based on a five-point Likert scale. In the second round, the mean ratings of the difficulties of implementing safety practices in the overseas projects of CICs were calculated and ranked.

Table 7.2 Strategies for improving safety management in CICs' overseas projects

Items	Description
S01	Deliver management commitment to safety and establish safety production responsibility system.
S02	Establish and implement perfect safety management system.
S03	Ensure safety budget.
S04	Raise workers' safety awareness.
S05	Provide safety training and education actively.
S06	Pay attention to design, technology and equipment safety.
S07	Manage subcontractors' safety in-depth and comprehensively.
S08	Concern about workers' physical and mental state.
S09	Construct safety culture.
S10	Develop particular safety measures for assigned region and assigned projects.
S11	Fully consider safety cost during the bidding phase.
S12	Overcome language barriers to conduct effective safety communication on site.
S13	Communicate with the developer and the government department on construction safety regularly.
S14	Communicate with the home office and regional headquarters on construction safety regularly.
S15	Consider the local culture, customs and religious belief.
S16	Employ local safety management staff and professionals.

The statistical data analysis was conducted. The mean ratings and rankings of them are shown in Tables 7.3 and 7.4. After conducting the survey, the panel identified the five most important strategies for improving safety management in CICs' overseas projects to be raise workers' safety awareness, provide safety training and education actively, ensure safety budget, manage subcontractors' safety in-depth and comprehensively, and pay attention to design, technology and equipment safety.

Tables 7.3 and 7.4 also shows that Kendall's W values of all experts in the two rounds were 0.148 and 0.207 respectively. W values were increased along with a sequential Delphi survey rounds. The chi-square values in the two rounds were 57.602 and 80.589 respectively, both statistically significant. Therefore, significant consensus among all experts was confirmed. Conducting the two-round Delphi survey successfully contributed to improving the agreement among all experts and the reliability of the results. Rating agreement was also improved within the Middle East group at significant level. Kendall's W value of the Middle East group increased from 0.340 in the first round to 0.345 in the second round. Although W values of Southeast Asia and Africa groups could not reach significant levels in the first round of survey, significant consensuses were confirmed in the second round. The Kendall's W values of the Southeast Asia and Africa groups in the second round were 0.266 and 0.229, respectively. The Kendall's W values for the others group were not significant in two rounds of survey. The Wilcoxon signed-rank test was used to compare the repeated measurements in two rounds of Delphi survey. As shown in Table 7.5, all 16 items were tested to be insignificant, representing there was no significant difference between the experts' ranks of items in the two rounds.

Table 7.3 Results of round-one Delphi survey: Strategies for improving safety management in CICs' overseas projects

Items	All experts		Southeast Asia		The Middle East		Africa		Others		Kruskal-Wallis test
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Asymp. sig.
S01	3.81	6	4.25	6	3.86	9	3.38	6	3.67	4	.420
S02	3.81	6	4.25	6	4	6	3.25	7	3.67	4	.301
S03	4.15	3	4.63	3	4.14	3	3.88	1	3.67	4	.190
S04	4.23	1	4.88	1	4.57	1	3.5	4	3.67	4	.014
S05	4.19	2	4.75	2	4.43	2	3.63	2	3.67	4	.059
S06	3.92	4	4.63	3	4	6	3.13	8	4	1	.051
S07	3.88	5	4.5	5	3.71	10	3.5	4	3.67	4	.107
S08	3.46	14	4.25	6	2.86	15	3.13	8	3.67	4	.019
S09	3.62	11	4.25	6	4.14	3	2.75	15	3	16	.010
S10	3.81	6	4.25	6	4.14	3	3	11	4	1	.118
S11	3.73	10	4.13	12	4	6	3	11	4	1	.220
S12	3.62	11	4.25	6	3.71	10	3	11	3.33	11	.087
S13	3.54	13	4.13	12	3.43	13	3.13	8	3.33	11	.089
S14	3	16	3.88	16	2.71	16	2.25	16	3.33	11	.014
S15	3.35	15	4	15	3	14	3	11	3.33	11	.305
S16	3.77	9	4.13	12	3.71	10	3.63	2	3.33	11	.650
Number	26		8		7		8		3		
Kendall's W	.148		.206		.340		.155		.214		
Chi-Square	57.602		24.754		35.671		18.542		9.608		
Asymp. Sig.	.000		.053		.002		.235		.844		

Table 7.4 Results of round-two Delphi survey: Strategies for improving safety management in CICs' overseas projects

Items	All experts		Southeast Asia		The Middle East		Africa		Others		Kruskal-Wallis test
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Asymp. sig.
S01	3.77	9	4.25	7	3.86	9	3.38	5	3.33	13	0.141
S02	3.65	12	4.25	7	4	7	3	11	3	16	0.026
S03	4.19	3	4.5	3	4.29	3	4	1	3.67	6	0.293
S04	4.35	1	4.88	1	4.71	1	3.75	2	3.67	6	0.024
S05	4.27	2	4.75	2	4.57	2	3.63	4	4	1	0.074
S06	3.92	5	4.38	4	4.14	5	3.25	8	4	1	0.038
S07	4	4	4.38	4	3.86	9	3.75	2	4	1	0.388
S08	3.69	10	4.13	11	3.57	14	3.38	5	3.67	6	0.330
S09	3.69	10	4	12	4.14	5	3	11	3.67	6	0.019
S10	3.85	6	4.25	7	4.29	3	3	11	4	1	0.037
S11	3.81	7	4.25	7	4	7	3.13	10	4	1	0.058
S12	3.81	7	4.38	4	3.71	11	3.38	5	3.67	6	0.017
S13	3.54	14	3.88	15	3.71	11	3	11	3.67	6	0.095
S14	3.08	16	3.88	15	2.86	16	2.38	16	3.33	13	0.018
S15	3.31	15	4	12	3.29	15	2.63	15	3.33	13	0.068
S16	3.65	12	4	12	3.71	11	3.25	8	3.67	6	0.556
Number	26		8		7		8		3		
Kendall's W	.207		.266		.345		.229		.325		
Chi-Square	80.589		31.905		36.237		27.494		14.642		
Asymp. Sig.	.000		.007		.002		.025		.478		

Table 7.5 Wilcoxon Signed-Rank test of two rounds Delphi survey results: Strategies for improving safety management in CICs' overseas projects

Items	Wilcoxon Signed-Rank test	
	Z-value	Asymp. Sig.
S01	-0.447	0.655
S02	-1.069	0.285
S03	-0.577	0.564
S04	-1.342	0.180
S05	-1.000	0.317
S06	0.000	1.000
S07	-1.342	0.180
S08	-1.730	0.084
S09	-0.707	0.480
S10	-0.577	0.564
S11	-0.816	0.414
S12	-1.508	0.132
S13	0.000	1.000
S14	-1.414	0.157
S15	0.000	1.000
S16	-1.134	0.257

Agreement of experts from different regions

The Kruskal-Wallis test was used to compare the experts' opinions among various region groups. An insignificant result indicates that agreement among different region groups is achieved. As shown in Table 7.3, S04, S08, S09 and S14 were confirmed to be significant of Kruskal-Wallis test in the first round, indicating that agreement among different region groups could not be achieved for these four items. In the second round, four more items including S02, S06, S10 and S12 were further tested to be significant, whereas S08 were tested to be insignificant in this round of Delphi survey (Table 7.4). Mann-Whitney U test was conducted for pairwise comparison among four groups for these seven items, and the results are shown in Table 7.6. All these items were tested to be significant between Southeast Asia group and Africa group, suggesting the disagreement of opinions between experts from Southeast Asia and Africa.

Table 7.6 Results of Mann-Whitney U test for the Kruskal-Wallis test significant items

Items	Southeast Asia vs. The Middle East	Southeast Asia vs. Africa	Southeast Asia vs. Others	The Middle East vs. Africa	The Middle East vs. Others	Africa vs. Others
S2	.428	.015*	.065	.037*	.094	1.000
S4	.453	.029*	.008**	.087	.032*	.915
S6	.504	.010*	.236	.058	.673	.154
S9	.702	.012*	.498	.006**	.301	.094
S10	1.000	.025*	.473	.018*	.326	.108
S12	.032*	.005**	.094	.204	.886	.409
S14	.052	.004**	.155	.487	.267	.072

7.3.2 Discussions

The Delphi survey results highlighted the importance of raising the safety awareness of workers, providing safety training and education actively, ensuring safety budget, managing the safety of subcontractors thoroughly and comprehensively, and paying attention to design, technology, and equipment safety.

Raising the safety awareness of workers in CICs' overseas projects is a constant theme, which can be achieved by instilling good safety culture, providing effective safety training, and enhancing safety investment. In addition, involving workers in accident analysis can improve their understanding and compliance of safety measures by increasing their knowledge of accident causation (Kouabenan, 2009). If the CICs aim to seek long-term development in undeveloped and developing countries, then they should not only resort to a series of forced strategies, such as imposing safety reward and penalty, but also introduce strategies of safety training and education to improve safety management levels on site (Mahalingam and Levitt, 2007). Forced strategies should be strictly implemented with the support of supervisors and the commitment of top management (Hon et al., 2011).

During safety training, attention should be paid to the following points. First, the courses should be tailored to suit for different construction trades, and workers from the same group should be trained together to encourage regular safety communication among workers (Casey and Krauss, 2013). Second, linguistically and culturally appropriate safety training should be provided to the workers in overseas projects. Mandatory safety training should be presented in the native language of workers with translated print materials (Trajkovski and Loosemore, 2006). Third, formal mechanical safety training courses should be administered when workers need to operate large machines. Failure to conduct a formal mechanical safety training can result in serious consequences. Fourth, providing safety training to workers of subcontractors on a continuous basis is crucial in improving safety performance on site. Workers of subcontractors should receive safety training and management programs that are comparable with those of the main contractors (Chen et al., 2012).

CICs should ensure safety budget in their overseas projects. Reducing accidents and improving safety management level are based on adequate safety budget. To guarantee construction safety in overseas projects, certain resources should be supplied, new equipment and safety technology should be promoted, and obsolete equipment and technology should be outdated accordingly. CICs should ensure safety investment in training and equipment updating. Furthermore, main contractors should conduct overall control to safety budget and avoid deficiency of subcontractors in safety budget.

CICs should manage the safety of subcontractors thoroughly and comprehensively. Before subcontracting any construction work, the safety qualification of potential subcontractors should be strictly examined. When signing a subcontracting contract, specifying safety management in contract terms is necessary. In the construction stage, safety schemes and measures prepared by subcontractors should be examined to meet safety requirements. Safety inspection of the equipment and safety facilities of subcontractors should also be conducted regularly.

CICs should pay attention to design, technology, and equipment safety, especially in Engineering-Procurement-Construction (EPC) projects. Many potential safety hazards occur in the phases of project design and procurement. CICs should consider safety problems and strengthen design management in the design phase to avoid or eliminate potential safety hazards in construction and operation, which are caused by unreasonable design and design defects. CICs should pay more attention in the purchase phase to avoid fake and inferior products or materials, thereby ensuring safety during equipment installation and operation. Identification of hazards should be performed and construction risk should be analyzed according to the specific condition of projects. After hazard identification, measures of prevention and controlling potential dangers should be made. Hazards should be controlled through elimination, isolation, and diversion to further prevent accidents. Construction includes multiple types of work with a large quantity of different categories of materials and equipment; thus, factors that affect construction safety are rather complex. Effective safety technical measures should be guaranteed to eliminate potential safety hazards existing in construction, thereby reducing and avoiding accidents. Emergency response mechanism should be designed and exercised. Supervision, inspection, and audit are important to ensure the implementation of safety measures. Regular safety inspection should be conducted to check physical conditions and work practices. Equipment should be examined to determine whether its operation presents any hazards. Work practices should be observed to identify potential hazards and unsafe actions. Safety audit should also be conducted to measure the reliability and effectiveness of safety inspections, programs, trainings, plans, and systems in CICs' overseas projects.

CICs should also care for the work and life balance of their employees. Many overseas projects are far away from China. Chinese workers in overseas projects feel intense loneliness and distance because of the differences in culture, regions, and customs, as well as barriers in communication; thus, they should be guided and taken care of in terms of both their work and life. A relatively comfortable working and living environment should be created, to make employees have a sense of belongingness. Communication between foreman and workers should be enhanced to ensure high motivation among workers. Adjustments should be arranged in advance if a worker is in a bad mood to avoid any risks.

7.4 CHAPTER SUMMARY

This chapter has presented qualitative research findings and practical implications from quantitative research findings in the identification of strategies for improving construction safety in CICs' overseas project. These identified strategies have been further ranked and validated in the Delphi survey. The five most important strategies ranked by the experts are: 1) raise workers' safety awareness; 2) provide safety training and education actively; 3) ensure safety budget; 4) manage subcontractors' safety in-depth and comprehensively; and 5) pay attention to design, technology and equipment safety.

CHAPTER 8 CONCLUSIONS

8.1 INTRODUCTION

This chapter summarizes the major research findings and restates the significance and contributions of the current study. It also discusses the limitations of the study and provides suggestions for future research directions.

8.2 SUMMARY OF THE MAJOR RESEARCH FINDINGS

8.2.1 Problems of construction safety management and difficulties of implementing practices in CICs' overseas projects

This study has revealed 16 problems of managing construction safety and 16 difficulties of implementing safety practices in CICs' overseas projects from document analysis and structured interview. The identified problems and difficulties have been further ranked in the two-round Delphi survey. The five most important problems of safety management in the overseas projects of CICs are: 1) weak safety awareness of local workers; 2) low safety management ability of local subcontractors; 3) inadequate safety budget; 4) mental and physical fatigue of Chinese workers; and 5) unclear responsibility for construction safety in CICs' overseas projects. The four most important difficulties of implementing safety practices in the overseas projects of CICs are: 1) labor-only subcontracting and complex labor structure; 2) difficulty in changing weak safety awareness of local workers; 3) high turnover rates of frontline workers; and 4) inability of Chinese workers who work far from home to adapt to a boring lifestyle in overseas projects.

8.2.2 Safety climate structure in CICs' overseas projects

Four safety climate factors in CICs' overseas projects have been identified in this study by EFA. A four-factor first-order safety climate model was then validated by applying a CFA on the other half of the data. The safety climate factors in CICs' overseas projects include: top management commitment (TMC), indicating the attitude toward safety of top management level in the organization; supervisors' expectation (SE), focusing on supervisors' attitude toward construction safety; coworkers' caring and communication (CCC), reflecting coworkers' opinion on communicating with other workers and their will to help other workers; and, coworkers' role models (CRM); indicating coworkers' safety behaviors that could provide a fine example to other workers.

8.2.3 Relationship between safety climate and safety performance in CICs' overseas projects

This study explores the underlying mechanisms of the relationship between safety climate factors and safety performance. With an integrated model by SEM, all five proposed hypotheses are tested and supported. FRTO (TMC) is positively related to FRTS (SE) and FRTCs (CCC and CRM) significantly. FRTS (SE) could partially mediate the relationship between FRTO (TMC) and FRTCs (CCC and CRM), as well as the relationship between FRTO (TMC) and safety performance. FRTCs (CCC and CRM) play a statistically significant partial mediation role in the relationship between FRTO (TMC) and safety performance, and the relationship between FRTS (SE) and safety performance.

8.2.4 Factors affecting safety climate in CICs' overseas projects

The hierarchical logistic regression analysis results indicate that nationality, religious belief, and employment mode can partially affect safety climate factors. Project managers should pay more attention to safety management in international construction projects than in domestic projects, and keep their eyes open on factors that can influence safety climate.

8.2.5 Strategies for improving construction safety in CICs' overseas projects

16 strategies for improving safety management in CICs' overseas projects have been developed from qualitative research findings and practical implications from quantitative research findings. These identified strategies are further validated in the two-round Delphi survey. The five most important strategies ranked by the experts are: 1) raise workers' safety awareness; 2) provide safety training and education actively; 3) ensure safety budget; 4) manage subcontractors' safety in-depth and comprehensively; and 5) pay attention to design, technology and equipment safety.

8.3 SIGNIFICANCE AND CONTRIBUTIONS

This research has made three significant contributions to the research area of construction safety. The first contribution was to identify a new area of safety improvement and research interest. The increasingly important role of CICs in the international construction market, the significance of safety management in construction projects, and the unique characteristics of CICs' overseas projects all highlight the importance of studying construction safety management in CICs' overseas projects. However, the amount of literature available in this area is quite limited. This study bridges some of the gaps in this area. It has developed an understanding of the safety management practices, has identified the problems encountered, and has recommended some strategies for improving construction safety in CICs' overseas projects. Other international contractors, especially those from developing countries, could also benefit from this study by understanding the similar situations they might meet in their own overseas projects.

The second contribution was to derive safety climate factors and explore the underlying mechanisms of the relationship between safety climate factors and safety performance in CICs' overseas projects. Despite the large number of safety climate studies in the construction industry and the persistent research interest for international contracting, there have been only a handful of studies on safety research in international construction, and almost none on safety climate, not to mention that in CICs' overseas projects. As safety climate often varies in different sectors and settings, the unique characteristics of the international construction projects may lead to different safety climate factors from those in common projects. The existing safety climate studies could not fully represent the situation in CICs' overseas projects and this study bridges some of the gaps.

The third contribution was to find out several specific factors that may affect safety climate in international construction projects. Participants from various countries and regions are involved in international construction projects, for both management staff and frontline workers. This study has identified that nationality, religious belief, and employment mode can partly affect safety climate factors.

Although it focusses on the Chinese international construction contexts, other international contractors, could also benefit from this study by understanding the potential factors that may affect safety climate in their own overseas projects.

8.4 LIMITATIONS OF THE STUDY

This study draws several limitations. First, like any other opinion-based study, this study is subjected to bias and imprecise definition. In the research, document analysis, structured interview, and Delphi survey were conducted to understand and solicit the opinions from industrial practitioners. The research results rely on the experience and knowledge of these practitioners and experts. The subjectivity of the evaluation could not be eliminated completely. The influence of this limitation could be further reduced by conducting the research with larger sample size.

Second, self-reported questionnaire survey was implemented to collect data related to safety climate in the current study, leading to common methods bias. To control and alleviate its effects, several techniques have been adopted. At the questionnaire design stage, a number of reverse-coded items were included in the scales to reduce the possible effects of response pattern bias. At the questionnaire administration stage, the participants were notified that their responses were anonymous and confidential, and answers were not right or wrong, and therefore they should answer questions as frankly as possible.

Third, the source of document analysis is mainly from publications of trade journals of China International Contractors Association. The interviewees and Delphi survey experts are mainly from main contractors. This may lead to contractor bias. Although the research topic is regarding international contractors and CICs with hands-on experience are most likely to be people in proximity to accidents, it would be much better to solicit some examples from other trades.

Fourth, although the projects investigated are kind of representative among the whole international construction market by CICs, the questionnaire research findings are limited to samples among CICs in their Vietnamese projects. There is potential bias to generalize conclusions from samples to populations. The application of the research findings to other regions or countries is subject to further verifications. Country and cultural specificities could impact on the findings. Hence, similar research in other regions or countries should be conducted for cross-comparisons and generalization of research conclusions.

8.5 FUTURE RESEARCH DIRECTIONS

Considering this research is regional in nature, future research should be carried out more broadly within international construction projects by CICs in different countries and regions to validate the research findings. Comparisons could be made among different areas as well. Chinese domestic projects could also be considered as a benchmarking.

In addition, the longitudinal questionnaire study could be conducted to supplement the current cross-sectional questionnaire study. As this study uses self-report questionnaires to measure safety performance, objective measures of safety performance can be obtained in the future.

8.6 CHAPTER SUMMARY

This chapter has summarized the major research findings, has restated the significance and contributions, and has discussed the limitations of the current study. It has also provided suggestions for future research directions.

APPENDICES

APPENDIX A: RESEARCH INTERVIEW INVITATION LETTERS AND QUESTIONS

Invitation letter (English Version)

Invitation to Participate in an Interview regarding a Research Project on Managing Construction Safety in Chinese International Contractors' Overseas Projects

Dear Sir,

I would like to invite you to participate in an interview regarding a research project conducted by the Construction Safety and Health Research Group of the Department of Building and Real Estate at the Hong Kong Polytechnic University, which is titled "Managing Construction Safety in Chinese International Contractors' Overseas Projects".

Driven by the national "going global" strategy, Chinese construction enterprises have become increasingly active in international market. According to the survey conducted by Engineering News Record, a total of 55 Chinese mainland construction enterprises were included within the top 250 international contractors based on the revenues generated overseas in 2013. However, compared with advanced international contractors, Chinese construction enterprises have distinct disadvantages, such as inadequate fund, indifferent technology and low level of management, among which low level of management in construction safety is an important factor that keeps Chinese companies from being most competitive international contractors. The accidents in international projects would not only lead to delay of schedule in a specific project and profit loss to a particular company, but also influence the international reputation of all Chinese companies. Therefore, study on managing construction safety in Chinese international contractors' overseas projects is of theoretical and practical significance. Our research project aims to provide recommendations to improve safety and health management level in Chinese international contractors.

You are cordially invited to give your precious opinion on the above mentioned topic. You may advise the time and interview type at your convenience (video interview or face-to-face interview). The interview would last for about half to one hour. You may use English or Chinese during the interview. Please be assured that the information you provide would be kept in strict confidence and your identity would not be disclosed. Your experience and expertise would be highly valuable and your participation in this research would contribute to improving safety and health in international projects and the construction industry as a whole.

Should you have any enquiries, please feel free to contact me at 00852 5168 or email to ran.gao@ . We are looking forward to your early reply.

Yours sincerely,

GAO Ran

PhD Student, Department of Building and Real Estate

The Hong Kong Polytechnic University

Invitation letter (Chinese Version)

访谈邀请函

尊敬的专家：

您好！我们是香港理工大学建筑及房地产学系施工安全与健康研究小组，目前正在进行一项有关海外工程项目施工安全管理的课题研究。据悉您是此领域经验丰富的专家，我们真诚地邀请您参与访谈，分享宝贵经验。

在“走出去”战略指导下，我国国际承包商大力发展海外工程项目，取得了不小的成绩。据《工程新闻纪录》（ENR）统计，55 家中国内地企业入选 2013 年度全球最大的 250 家国际承包商。尽管如此，我国国际承包商与发达国家国际承包商相比，存在资金、技术和管理等诸多方面的不足，安全管理水平不高是制约其发展的重要因素之一。海外工程承包项目事故的发生，不仅影响项目的施工进度，造成企业竞争力下降和利润损失，其敏感性也会损害中国企业的整体声誉。研究如何提高我国国际承包商的安全管理水平，具有重要的理论和现实意义。

您可根据个人便利，选择网络视频或面对面的形式参与访谈。访谈语言为中文或英文，整个访谈过程持续半小时至一小时。我们会对您提供的信息严格保密，不会外泄个人信息。课题完成后，我们会及时地将研究结果反馈给您。希望您能在百忙中应邀参与访谈！

如有疑问，请与高然同学联系。联系电话：（00852） 5168 ，邮箱：ran.gao@

访谈提纲 Interview question list

General questions	
1. 请介绍您所在项目的概况，包括：项目类型，合同类型，合同额，工期，合同条件（是否有专门的安全预算，并简述有关安全的条款，e.g. 安全程序，员工的健康和安全等），安全管理体系。	1. Please introduce your project(s) generally, e.g. project type, contract type, contract value, duration, contract conditions (safety budget in the BOQ, contract terms regarding safety, e.g. safety procedures, health and safety for staff and labor), safety management system.
2. 请问我国海外工程主要存在哪些施工安全和健康问题？	2. What are the main safety and health problems in Chinese international contractors' overseas projects?
3. 请问我国海外工程安全管理的措施有哪些？实行措施时有哪些障碍？	3. What are the measures of safety management in Chinese international contractors' overseas projects? Any difficulties to implement these measures?
4. 请问有哪些改善海外工程安全管理的建议？	4. Would you please give some recommendations for improving safety management in Chinese international contractors' overseas projects?
5. 您认为影响海外工程安全管理水平的因素有哪些？	5. What are the factors affecting safety management level among international projects?
Optional questions	
6. 请问您所在项目的中国工人、本地工人和第三国工人在一线工人中各占怎样的比例？分别从事什么工种？	6. What are the percentage of Chinese workers, local workers and workers from third countries in the frontline workers? What construction trades do they join each?
7. 请问国籍差异、宗教信仰和招聘方式是否影响一线工人的安全表现？	7. Do you think nationalities, religions and employment ways could affect workers' safety performance?

APPENDIX B: QUESTIONNAIRES

Questionnaire (English Version)

Section A: Personal Particulars (Please answer by ticking the most appropriate box □).

1. Your nationality: □Chinese □Vietnamese □Others_____
2. Your work trade: ______________________
3. Your age: □20 or below □21-30 □31-40 □41-50 □51 or above
4. Your gender: □Male □Female
5. Your marital status: □Single □Married
6. Number of family members supported by you (excluding yourself):
□0 □1 □2 □3 □4 □5 □6 □7 or above
7. Your education level:
   □Below primary □Primary □Junior middle school
   □High school □College □Bachelor or above
8. Do you have religious belief?
   □No □Yes
9. Your direct employer: □Main Contractor □Subcontractor □Others ___________
10. Length of service with the current company:
    □< 1 year □1-5 years □6-10 years □11-20 years □> 20 years
11. Working experience in the construction industry:
    □< 1 year □1-5 years □6-10 years □11-20 years □> 20 years
12. Have you received any safety training from the current company? □Yes □No
13. Have you received any safety training before you joined the current company? □Yes □No
14. A habit of smoking:
    □I don't smoke □I smoke, but not at work
    □I smoke even at work (including lunch time and break)
15. A habit of alcohol consumption:
    □I don't drink □I drink, but not at work
    □I drink even at work (including lunch time and break)

Section B: Safety Climate (Please circle the appropriate number to show your level of agreement with each of the following statements, where "1=strongly disagree", "2=disagree", "3= neutral", "4=agree" and "5=strongly agree").

Statement	☹ **Strongly disagree**	**Disagree**	😐 **Neutral**	**Agree**	☺ **Strongly agree**
1. Top management reacts quickly to solve the problem when told about safety hazards.	1	2	3	4	5
2. Top management insists on thorough and regular safety audits and inspections.	1	2	3	4	5
3. Top management tries to continually improve safety levels for the whole project.	1	2	3	4	5
4. Top management provides all the equipment needed to do the job safely.	1	2	3	4	5
5. Top management is strict about working safely when work falls behind schedule.	1	2	3	4	5
6. Top management quickly corrects any safety hazard (even if it's costly)	1	2	3	4	5
7. Top management provides detailed safety reports to workers (e.g. injuries, near accidents).	1	2	3	4	5
8. Top management considers a person's safety behavior when moving/promoting people.	1	2	3	4	5
9. Top management requires each supervisor to help improve safety in his/her group.	1	2	3	4	5
10. Top management invests a lot of time and money in safety training for workers.	1	2	3	4	5
11. Top management uses any available information to improve existing safety rules.	1	2	3	4	5
12. Top management listens carefully to workers' ideas about improving safety.	1	2	3	4	5
13. Top management considers safety when setting production speed and schedules.	1	2	3	4	5
14. Top management provides workers with a lot of information on safety issues.	1	2	3	4	5

Statement	☹ Strongly disagree	Disagree	😐 Neutral	Agree	☺ Strongly agree
15. Top management regularly holds safety-awareness events (e.g. presentations, ceremonies).	1	2	3	4	5
16. Top management gives safety personnel the power they need to do their job.	1	2	3	4	5
17. My supervisor says a good word whenever he sees a job done according to the safety rules.	1	2	3	4	5
18. My supervisor seriously considers any worker's suggestions for improving safety.	1	2	3	4	5
19. My supervisor approaches workers during work to discuss safety issues.	1	2	3	4	5
20. My supervisor gets annoyed with any worker ignoring safety rules, even minor rules.	1	2	3	4	5
21. My supervisor watches more often when a worker has violated some safety rules.	1	2	3	4	5
22. As long as there is no accident, my supervisor doesn't care how the work is done.	1	2	3	4	5
23. Whenever pressure builds up, my supervisor wants us to work faster, rather than by the rules.	1	2	3	4	5
24. My supervisor pays less attention to safety problems than most other supervisors in this project.	1	2	3	4	5
25. My supervisor only keeps track of major safety problems and overlooks routine problems.	1	2	3	4	5
26. As long as work remains on schedule, my supervisor doesn't care how this has been achieved.	1	2	3	4	5
27. My coworkers emphasize safety procedures when we are working under pressure.	1	2	3	4	5
28. My coworkers are strict about safety also at the end of the shift.	1	2	3	4	5

Statement	☹ **Strongly disagree**	**Disagree**	😐 **Neutral**	**Agree**	☺ **Strongly agree**
29. My coworkers constantly remind workers to work safely.	1	2	3	4	5
30. If it is necessary, my coworkers will persuade other coworkers to act safely.	1	2	3	4	5
31. My coworkers talk about safety issues all the way.	1	2	3	4	5
32. My coworkers spend time helping other coworkers identify hazardous condition before problem arise.	1	2	3	4	5
33. My coworkers concern about whether other members have received all the equipment required to work safely.	1	2	3	4	5
34. My coworkers are careful about working safely even when they are tired or stressed.	1	2	3	4	5
35. My coworkers tell me about the hazards in our work.	1	2	3	4	5
36. My coworkers remind the other coworkers to wear their protective equipment even though it may be uncomfortable.	1	2	3	4	5
37. My coworkers are careful that the other coworkers are obeying the safety rules.	1	2	3	4	5
38. My coworkers are strict about safety rules even when work falls behind schedule and under pressure from our direct supervisor.	1	2	3	4	5

Section C: Criteria (Please circle the appropriate number to show your level of agreement with the following statements, where "1=strongly disagree", "2=disagree", "3= neutral", "4=agree" and "5=strongly agree")

Statement	☹ **Strongly disagree**	**Disagree**	😐 **Neutral**	**Agree**	☺ **Strongly agree**
➢ *Safety compliance*					
1. I use all the necessary safety equipment to do my job.	1	2	3	4	5
2. I use the correct safety procedures for carrying out my job.	1	2	3	4	5
3. I ensure the highest levels of safety when I carry out my job.	1	2	3	4	5
➢ *Safety participation*					
1. I promote the safety program within the organization.	1	2	3	4	5
2. I put in extra effort to improve the safety of the workplace.	1	2	3	4	5
3. I voluntarily carry out tasks or activities that help to improve workplace safety.	1	2	3	4	5

Thank you for your participation.

Should you have any queries, please contact Ms. Ran GAO at (+852) 5168 or email to ran.gao@ .

Questionnaire (Chinese Version)

问卷调查

第一部分：个人信息 （请在合适选项前面的方框内打勾）

1. 国籍： □中国籍 □越南籍 □其他______
2. 工种：______________________
3. 年龄： □20 岁及以下 □21-30 岁 □31-40 岁 □41-50 岁 □51 岁及以上
4. 性别： □男 □女
5. 婚姻状况： □未婚 □已婚
6. 需要您养活的家庭成员数（可以是您的父母、子女、配偶等，但是***不包括***您自己）：

□0 □1 □2 □3 □4 □5 □6 □7 及以上

7. 教育水平： □小学未毕业 □小学 □初中毕业 □高中毕业 □大中专毕业 □本科及以上
8. 宗教信仰情况： □无 □有
9. 您目前所在的公司是： □总包商 □分包商 □其他__________
10. 您在现在公司的工作年限：
    □少于 1 年 □1-5 年 □6-10 年 □11-20 年 □超过 20 年
11. 您在建筑行业的从业年限：
    □少于 1 年 □1-5 年 □6-10 年 □11-20 年 □超过 20 年
12. 您在现在的公司接受过安全培训吗？ □接受过 □没接受过
13. 您在没加入现在的公司之前，曾经接受过安全培训吗？ □接受过 □没接受过
14. 抽烟习惯： □我不抽烟 □我抽烟，但是在上班时间不抽 □我上班时间也抽烟（上班时间包括午饭和中途休息时间）
15. 喝酒习惯： □我不喝酒 □我喝酒，但是在上班时间不喝 □我上班时间也喝酒（上班时间包括午饭和中途休息时间）

第二部分：安全气候 （请根据您的同意程度，对以下描述进行打分，其中“1=非常不同意”，“2=不同意”，“3=中立”，“4=同意”，“5=非常同意”。）

描述	☹非常不同意	不同意	😐中立	同意	☺非常同意
1. 当我发现安全隐患并上报管理层后，他们马上开始解决问题。	1	2	3	4	5
2. 管理层定期在现场进行全面的安全监督检查。	1	2	3	4	5
3. 管理层为持续提高整个项目的安全管理水平做出努力。	1	2	3	4	5
4. 管理层提供安全施工所需的一切设备措施。	1	2	3	4	5
5. 即使施工进度落后于计划，管理层仍然严格坚持安全施工。	1	2	3	4	5
6. 管理层发现危险情况后立即解决，即使这样做花费巨大。	1	2	3	4	5
7. 管理层为工人提供详细的安全报告（如工伤报告等）。	1	2	3	4	5
8. 管理层在提拔员工时会参考其安全作业记录。	1	2	3	4	5
9. 管理层要求每位班组长提升本班组的安全作业水平。	1	2	3	4	5
10. 管理层在安全培训上花费很多时间和财力。	1	2	3	4	5
11. 管理层不断改善现有的安全规定。	1	2	3	4	5
12. 管理层愿意听取工人关于改善安全管理的建议。	1	2	3	4	5
13. 管理层在制定进度计划时考虑安全施工因素。	1	2	3	4	5

描述	☹非常不同意	不同意	😐中立	同意	☺非常同意
14. 管理层给工人提供很多安全方面的信息。	1	2	3	4	5
15. 管理层定期举办增强安全意识的活动。	1	2	3	4	5
16. 现场施工中，管理层赋予了安全管理人员工作所需的权力。	1	2	3	4	5
17. 当看到工人按安全规定操作时，我的工长会表扬他。	1	2	3	4	5
18. 我的工长认真考虑工人提出的改善安全管理的建议。	1	2	3	4	5
19. 我的工长平时和工人讨论如何安全施工。	1	2	3	4	5
20. 如果有工人不按安全规定操作（即使轻微违反规定），我的工长会表示不满。	1	2	3	4	5
21. 如果有工人曾经违反安全规定，我的工长会更加注意监视他。	1	2	3	4	5
22. 只要不发生事故，我的工长不关心施工是如何完成的。	1	2	3	4	5
23. 工期紧时，我的工长希望工人提高速度，降低安全标准。	1	2	3	4	5
24. 与项目其他大部分的工长相比，我的工长不够重视安全施工问题。	1	2	3	4	5
25. 我的工长只关注关键作业的安全问题，忽视日常的安全施工。	1	2	3	4	5
26. 只要完成工程进度，我的工长不在乎施工是如何完成的。	1	2	3	4	5
27. 当工期紧、压力大时，我的工友们仍然遵守安全程序。	1	2	3	4	5
28. 临近收工时，我的工友们仍然安全施工。	1	2	3	4	5

描述	☹非常不同意	不同意	😐中立	同意	☺非常同意
29. 我的工友们提醒其他工人要安全施工。	1	2	3	4	5
30. 必要时，我的工友们会亲自示范，指导其他工人安全施工。	1	2	3	4	5
31. 我的工友们经常谈论安全施工的话题。	1	2	3	4	5
32. 我的工友们花费精力帮助其他工人预防事故的发生。	1	2	3	4	5
33. 我的工友们关心其他工人是否收到了必需的安全防护设施。	1	2	3	4	5
34. 疲劳时，我的工友们仍然注意安全施工。	1	2	3	4	5
35. 我的工友们告诉其他工人施工中存在的安全隐患。	1	2	3	4	5
36. 我的工友们提醒其他工人穿戴安全防护设施，虽然穿起来不舒服。	1	2	3	4	5
37. 我的工友们关心其他工人是否遵守安全规定。	1	2	3	4	5
38. 工期延误或工长忽视安全管理时，我的工友们仍然遵守安全规定。	1	2	3	4	5

第三部分：评价指标 （请根据您的同意程度，对以下描述进行打分，其中“1=非常不同意”，“2=不同意”，“3=中立”，“4=同意”，“5=非常同意”。）

描述	☹非常不同意	不同意	😐中立	同意	☺非常同意
➢ *安全服从*					
1. 施工作业时，我使用一切所需的防护措施（如安全鞋、安全帽、防护面具等）。	1	2	3	4	5
2. 施工作业时，我遵循正确的安全程序。	1	2	3	4	5
3. 施工作业时，我始终严格遵守各项安全规定。	1	2	3	4	5
➢ *安全参与*					
1. 我主动推进公司的安全计划。	1	2	3	4	5
2. 我主动努力提升工地的安全状况。	1	2	3	4	5
3. 我主动承担起提升工地安全状况的任务和活动。	1	2	3	4	5

感谢您的参与！如果您对本问卷有任何疑问，请与高然联系。

电话：（+852）5168　　　　　邮箱：ran.gao@

Questionnaire (Vietnamese Version)

PHIẾU ĐIỀU TRA

Phần thứ nhất: thông tin cá nhân (chọn thông tin phù hợp bằng cách tích vào ô vuông)

1. Quốc tịch: □Trung Quốc □Việt Nam □nước khác:__________
2. Nghề nghiệp:__________
3. Tuổi: □dưới 20 tuổi □21-30 tuổi □31-40 tuổi □41-50 tuổi □trên 51 tuổi
4. Giới tính: □Nam □Nữ
5. Tình trạng hôn nhân: □chưa kết hôn □đã kết hôn
6. Số thành viên trong gia đình bạn phải nuôi dưỡng (có thể là cha mẹ, con cái, vợ chồng…, tất nhiên ***<u>không tính</u>*** bản thân bạn):
□0 □1 □2 □3 □4 □5 □6 □7 người trở lên
7. Trình độhọc vấn:
□chưa tốt nghiệp tiểu học □tiểu học □tốt nghiệp cấp 2
□tốt nghiệp cấp 3 □trung cấp/cao đẳng □đại học và trên đại học
8. Tôn giáo: □không □Cơ
9. Công ty hiện bạn đang làm là: □tổng thầu □nhà thầu phụ □khác:__________
10. Số năm làm việc của bạn ở công ty hiện tại:
□ít hơn 1 năm □1 đến 5 năm □6 đến 10 năm □11 đến 20 năm □hơn 20 năm
11. Số năm làm việc của bạn trong lĩnh vực xây dựng:
□ít hơn 1 năm □1 đến 5 năm □6 đến 10 năm □11 đến 20 năm □hơn 20 năm
12. Bạn đã từng được đào tạo về kĩ năng an toàn ở công ty hiện tại chưa? □đã từng □chưa từng
13. Trước khi vào làm công ty này, bạn từng được đào tạo kĩ năng an toàn chưa? □đã từng □chưa từng
14. Thói quen hút thuốc: □không hút thuốc □tôi hút thuốc, nhưng trong thời gian làm việc thì không □hút thuốc cả trong thời gian làm việc (bao gồm cả thời gian nghỉ giữa giờ)
15. Thói quen uống rượu: □không uống rượu □uống rượu, nhưng trong thời gian làm việc thì không □uống rượu cả trong thời gian làm việc (bao gồm cả thời gian nghỉ giữa giờ)

Phần thứ ba: chỉ tiêu đánh giá (Cho điểm theo mức độ đồng ý của bạn, trong đó "1= rất không đồng ý", "2 = không đồng ý", "3 = bình thường", "4 = đồng ý", "5 = rất đồng ý")

Mô tả	☹ **Rất không đồng ý**	**Không đồng ý**	😐 **Bình thường**	**Đồng ý**	☺ **Rất đồng ý**
1. Khi tôi phát hiện có vấn đề rủi ro an toàn và báo cho cấp quản lý thì họ nhanh chóng giải quyết.	1	2	3	4	5
2. Cấp quản lý thường xuyên kiểm tra giám sát vấn đề an toàn lao động tại công trường.	1	2	3	4	5
3. Cấp quản lý rất nỗ lực trong việc nâng cao trình độ quản lý an toàn công trình.	1	2	3	4	5
4. Cấp quản lý cung cấp đầy đủ thiết bị cần thiết để công nhân làm việc an toàn.	1	2	3	4	5
5. Ngay cả khi tiến độ thi công chậm so với kế hoạch, cấp quản lý vẫn tuân thủ nghiêm ngặt vấn đề an toàn xây dựng.	1	2	3	4	5
6. Nếu phát hiện thấy tình huống nguy hiểm, mặc dùtốn kém, công ty vẫn lập tức giải quyết.	1	2	3	4	5
7. Cấp quản lý cung cấp báo cáo an toàn chi tiết cho công nhân (như báo cáocác trường hợp tai nạn xảy ra trong công ty).	1	2	3	4	5
8. Khi tiến hành đề bạt một nhân viên, cấp quản lý sẽ tham khảo hồ sơ an toàn lao động của người đó trước đây.	1	2	3	4	5

Mô tả	☹ **Rất không đồng ý**	**Không đồng ý**	😐 **Bình thường**	**Đồng ý**	☺ **Rất đồng ý**
9. Cấp quản lý yêu cầu mỗi tổ trưởng phải nâng cao ý thức an toàn cho mỗi thành viên trong tổ mình.	1	2	3	4	5
10. Cấp quản lý dành nhiều thời gian và tiền bạc cho việc đào tạo an toàn lao động cho công nhân.	1	2	3	4	5
11. Cấp quản lý liên tục cải thiện quy định an toàn hiện có.	1	2	3	4	5
12. Cấp quản lý chịu lắng nghe ý kiến của công nhân về cải thiện an toàn lao động.	1	2	3	4	5
13. Cấp quản lý xem xét vấn đề an toàn thi công khi lên kế hoạch tiến độ xây dựng.	1	2	3	4	5
14. Cấp quản lý cung cấp nhiều thông tin an toàn lao động cho công nhân.	1	2	3	4	5
15. Cấp quản lý thường xuyên tổ chức các hoạt động nâng cao ý thức an toàn lao động (như các buổi thuyết trình, lễ kỉ niệm).	1	2	3	4	5
16. Tại công trường, cấp quản lý trao quyền cần thiết cho nhân viên quản lý công tác an toàn lao động.	1	2	3	4	5
17. Khi thấy công nhân làm việc đúng theo quy định an toàn, quản đốc của tôi sẽ khen người đó.	1	2	3	4	5
18. Quản đốc nghiêm túc xem xét đề xuất cải thiện quản lý an toàn từ công nhân.	1	2	3	4	5
19. Quản đốc thường cùng với công nhân nói chuyện về vấn đề an toàn thi công.	1	2	3	4	5
20. Quản đốc của tôi sẽ tỏ thái độ không hài lòng nếu phát hiện công nhân vi phạm quy định an toàn (kể cả những vi phạm nhỏ).	1	2	3	4	5

Mô tả	☹ **Rất không đồng ý**	**Không đồng ý**	😐 **Bình thường**	**Đồng ý**	☺ **Rất đồng ý**
21. Quản đốc sẽ chú ý giám sát nhiều hơn đối với những công nhân từng vi phạm quy định an toàn.	1	2	3	4	5
22. Chỉ cần không để xảy ra tai nạn, quản đốc không quan tâm đến việc thi công hoàn thành như thế nào.	1	2	3	4	5
23. Khi phải gấp rút hoàn thành tiến độ công trình, quản đốc muốn công nhân phải gia tăng tốc độ và ít để tâm đến tiêu chuẩn an toàn.	1	2	3	4	5
24. So với các quản đốc khác, quản đốc của tôi chưa thật sự quan tâm đến vấn đề an toàn thi công.	1	2	3	4	5
25. Quản đốc chỉ quan tâm đến vấn đề an toàn của những công việc trọng điểm mà bỏ qua những vấn đề an toàn thi công hàng ngày.	1	2	3	4	5
26. Chỉ cần hoàn thành đúng tiến độ công trình, quản đốc của tôi sẽ không quan tâm đến việc thi công được hoàn thành như thế nào.	1	2	3	4	5
27. Khi cần gấp rút hoàn thành tiến độ, các công nhân làm chung với tôi vẫn tuân thủ trình tự an toàn lao động.	1	2	3	4	5
28. Khi sắp tan ca, các công nhân làm chung với tôi vẫn tiến hành thi công an toàn.	1	2	3	4	5
29. Các công nhân làm chung với tôi nhắc nhở các công nhân khác cần chú ý an toàn thi công.	1	2	3	4	5
30. Khi cần thiết, các công nhân làm chung với tôi trực tiếp làm mẫu, chỉ dạy cho các công nhân khác về an toàn thi công.	1	2	3	4	5

Mô tả	☹ **Rất không đồng ý**	**Không đồng ý**	😐 **Bình thường**	**Đồng ý**	☺ **Rất đồng ý**
31. Các công nhân làm chung với tôi thường quan tâm nhắc nhở nhau cần có ý thức về vấn đề an toàn lao động.	1	2	3	4	5
32. Các công nhân làm chung với tôi chịu bỏ công sức để giúp các công nhân khác phòng ngừa tai nạn có thể xảy ra.	1	2	3	4	5
33. Các công nhân làm chung với tôi quan tâm đến công nhân khác có nhận được thiết bị bảo hộ an toàn lao động hay chưa.	1	2	3	4	5
34. Khi mệt mỏi/căng thẳng, các công nhân làm chung vẫn chú ý đến vấn đề an toàn thi công.	1	2	3	4	5
35. Các công nhân làm chung với tôi nói với công nhân khác về rủi ro an toàn có thể xảy ra trong lúc thi công.	1	2	3	4	5
36. Các công nhân làm chung với tôi nhắc nhở công nhân khác cần mang thiết bị bảo hộ an toàn, mặc dù mang như vậy sẽ không được thoải mái.	1	2	3	4	5
37. Các công nhân làm chung nhắc nhở nhau tuân thủ các quy định an toàn.	1	2	3	4	5
38. Ngay cả khi chậm tiến độhoặc quản đốc xem nhẹ việc quản lý an toàn, các công nhân làm chung với tôi vẫn tuân thủ theo các quy định về an toàn.	1	2	3	4	5

Phần thứ hai: vấn đề an toàn (Cho điểm theo mức độ đồng ý của bạn, trong đó "1= rất không đồng ý", "2 = không đồng ý", "3 = bình thường", "4 = đồng ý", "5 = rất đồng ý")

Mô tả	☹ **Rất không đồng ý**	**Không đồng ý**	😐 **Bình thường**	**Đồng ý**	☺ **Rất đồng ý**
➢ ***Tuân thủ an toàn***					
1. Khi thi công, tôi sử dụng tất cả những thiết bị bảo hộ an toàn cần thiết (như giày an toàn, mũ an toàn, mặt nạ bảo vệ…)	1	2	3	4	5
2. Khi thi công, tôisử dụng đúng quy trình an toàn.	1	2	3	4	5
3. Khi thi công, tôi luôn tuân thủ nghiêm ngặt các hạng mục quy định về an toàn.	1	2	3	4	5
➢ ***Tham gia an toàn***					
1. Tôi chủ động thực hiện kế hoạch an toàn của công ty.	1	2	3	4	5
2. Tôi chủ động cố gắng cải thiện tình hình an toàn tại công trường.	1	2	3	4	5
3. Tôi chủ động gánh vác nhiệm vụ/ tham gia vào các hoạt động nâng cao ý thức an toàn tại công trường.	1	2	3	4	5

Cám ơn sự tham gia của bạn! nếu như bạn có bất kì thắc mắc nào về phiếu điều tra này, vui lòng liên hệ Gao Ran.

Điện thoại: (+852) 5168 Email: ran.gao@

APPENDIX C: DELPHI SURVEY QUESTIONNAIRES

Questionnaire of the Delphi Survey: Round 1 (English Version)

A Survey of Managing Construction Safety in Chinese International Contractors' Overseas Projects (Round 1 of Delphi Survey)

Dear Madam/Sir,

I would like to invite you to participate in a Delphi survey regarding a research project conducted by the Construction Safety and Health Research Group of the Department of Building and Real Estate at the Hong Kong Polytechnic University, which is titled "Managing Construction Safety in Chinese International Contractors (CICs)' Overseas Projects". This research project has been funded by the Research Grants Council of Hong Kong and The Hong Kong Polytechnic University.

Driven by the national "going global" strategy, Chinese construction enterprises have become increasingly active in international market. However, compared with advanced international contractors, Chinese construction enterprises have distinct disadvantages, such as inadequate fund, indifferent technology and low level of management, among which low level of management in construction safety is an important factor that keeps Chinese companies from being most competitive international contractors. The accidents in international projects would not only lead to delay of schedule in a specific project and profit loss to a particular company, but also influence the international reputation of all Chinese companies. Therefore, study on managing construction safety in CICs' overseas projects is of theoretical and practical significance. Our research project aims to provide recommendations to improve safety and health management level in CICs.

Delphi survey is a systematic and interactive research method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem. This study conducts a two-round Delphi survey. Both rounds provide the same information. The second round also includes the group data of the first round, and the expert has a chance to modify his answer with consideration of the group statistical data.

You are cordially invited to give your precious opinion on the above mentioned topic. Attached is the first round questionnaire of Delphi survey. Please be assured that the information you provide would be kept in strict confidence and your identity would not be disclosed. Your experience and expertise would be highly valuable and your participation in this research would contribute to improving safety and health in international projects and the construction industry as a whole.

Should you have any enquiries, please feel free to contact Miss GAO Ran at +852 5168 or email to ran.gao@. We are looking forward to your early reply.

Yours sincerely,

Ran GAO

Construction Safety and Health Research Group

Department of Building and Real Estate

The Hong Kong Polytechnic University

Section 1: Background information

1. Your name: _______________

2. Name of your company: _______________

3. Your current position: _______________

4. Country/ region your project located in: _______________

5. Your working experience in the construction industry:

□< 1 year □1-5 years □6-10 years □11-20 years □> 20 years

6. Your working experience in CICs' overseas projects:

□< 1 year □1-5 years □6-10 years □11-20 years □> 20 years

7. Type of your project (please tick the appropriate box □):

□ Buildings	□ Transportation	□ Petroleum
□ Power	□ Industrial	□ Water
□ Manufacturing	□ Sewer/Waste	□ Telecom
□ Hazardous Waste	□ Other _______________	

Section 2: Problems of construction safety management in CICs' overseas projects

To what extent do you think the following problems exist when manage construction safety in CICs' overseas projects? Please rate the following statements based on a scale from 1-5, where "1=strongly disagree" and "5=strongly agree".

S/N	**Problems of construction safety management in CICs' overseas projects**	**Rate**				
P01	CICs lack contracting and management experience in the project host country.	1	2	3	4	5
P02	The top management of CICs lack commitment to construction safety.	1	2	3	4	5
P03	Unclear responsibility for construction safety in CICs' overseas projects.	1	2	3	4	5
P04	Health and safety plan becomes a mere formality.	1	2	3	4	5
P05	Poor execution of safety management on site lead to potential safety hazard.	1	2	3	4	5
P06	Inefficient safety inspection and supervision.	1	2	3	4	5
P07	Inadequate safety budget.	1	2	3	4	5
P08	Short of professional safety staff.	1	2	3	4	5
P09	Backward construction safety technology and equipment.	1	2	3	4	5
P10	Insufficient supply of PPEs in good quality.	1	2	3	4	5
P11	Inadequate safety training and education.	1	2	3	4	5
P12	Mental and physical fatigue of Chinese workers.	1	2	3	4	5
P13	Weak safety awareness of local workers.	1	2	3	4	5
P14	Low safety management ability of local subcontractors.	1	2	3	4	5
P15	CICs lack safety control of subcontractors after contracting.	1	2	3	4	5
P16	Language barriers lead to poor safety communication.	1	2	3	4	5

Section 3: Difficulties of implementing safety practices in CICs' overseas projects

To what extent do you think the following difficulties exist when implement safety practices in CICs' overseas projects? Please rate the following statements based on a scale from 1-5, where "1=strongly disagree" and "5=strongly agree".

S/N	**Difficulties of implementing safety practices in CICs' overseas projects**	**Rate**				
D01	Different socio-economic development in the project host country and China.	1	2	3	4	5
D02	Different geographical climate in the project host country and China.	1	2	3	4	5
D03	Different customs in the project host country and China.	1	2	3	4	5
D04	Different laws and regulations in the project host country and China.	1	2	3	4	5
D05	Different standards and practices in the project host country and China.	1	2	3	4	5
D06	Shortage of materials in the project host country.	1	2	3	4	5
D07	Limited logistic support from home office.	1	2	3	4	5
D08	High turnover rates of frontline workers.	1	2	3	4	5
D09	Labor-only subcontracting and complex labor structure.	1	2	3	4	5
D10	Difficulty in changing weak safety awareness of local workers.	1	2	3	4	5
D11	Chinese workers are far from home and cannot adapt boring lifestyle in overseas projects.	1	2	3	4	5
D12	Tough projects (e.g. complex design, tight schedule).	1	2	3	4	5
D13	Different safety management concepts between the developer and the main contractor.	1	2	3	4	5
D14	Different safety management concepts between the main contractor and the subcontractors.	1	2	3	4	5
D15	Language barriers among project participants.	1	2	3	4	5
D16	Cultural Differences among project participants.	1	2	3	4	5

Section 4: Strategies for improving safety management in CICs' overseas projects

To what extent do you think the following strategies are useful to improve safety management in CICs' overseas projects? Please rate the following statements based on a scale from 1-5, where "1=strongly disagree" and "5=strongly agree".

S/N	Strategies for improving safety management in CICs' overseas projects	Rate				
S01	Deliver management commitment to safety and establish safety production responsibility system.	1	2	3	4	5
S02	Establish and implement perfect safety management system.	1	2	3	4	5
S03	Ensure safety budget.	1	2	3	4	5
S04	Raise workers' safety awareness.	1	2	3	4	5
S05	Provide safety training and education actively.	1	2	3	4	5
S06	Pay attention to design, technology and equipment safety.	1	2	3	4	5
S07	Manage subcontractors' safety in-depth and comprehensively.	1	2	3	4	5
S08	Concern about workers' physical and mental state.	1	2	3	4	5
S09	Construct safety culture.	1	2	3	4	5
S10	Develop particular safety measures for assigned region and assigned projects.	1	2	3	4	5
S11	Fully consider safety cost during the bidding phase.	1	2	3	4	5
S12	Overcome language barriers to conduct effective safety communication on site.	1	2	3	4	5
S13	Communicate with the developer and the government department on construction safety regularly.	1	2	3	4	5
S14	Communicate with the home office and regional headquarters on construction safety regularly.	1	2	3	4	5
S15	Consider the local culture, customs and religious belief.	1	2	3	4	5
S16	Employ local safety management staff and professionals.	1	2	3	4	5

Thank you for your participation.

Questionnaire of the Delphi Survey: Round 1 (Chinese Version)

关于海外工程项目施工安全管理的第一轮德尔菲调查问卷

尊敬的专家：

您好！我们是香港理工大学建筑及房地产学系施工安全与健康研究小组，目前正在进行一项有关"中国国际承包商海外工程项目施工安全管理"的课题研究（该课题获得香港研究资助局及香港理工大学的资助）。据悉您是此领域经验丰富的专家，我们真诚地邀请您参与此次问卷调查，分享宝贵经验。

在"走出去"战略指导下，我国国际承包商大力发展海外工程项目，取得了不小的成绩。尽管如此，我国国际承包商仍存在资金、技术和管理等诸多方面的不足，安全管理水平不高是制约其发展的重要因素之一。海外工程承包项目事故的发生，不仅影响项目的施工进度，造成企业竞争力下降和利润损失，其敏感性也会损害中国企业的整体声誉。研究如何提高我国国际承包商的安全管理水平，具有重要的理论和现实意义。

此次调研采用德尔菲法，即采用背对背的通信方式征询专家小组成员的意见，确保各位专家之间不发生横向联系，经过两轮的征询、归纳、修改，使专家小组的意见趋于集中。我们会在第一轮采集各位专家对问卷所提问题的看法，归纳汇总后，在第二轮匿名反馈给各位专家，让其考虑并修改第一轮意见。以下内容为第一轮调查问卷，请您根据自己的实际经历填写，您提供的信息将仅用于本项课题研究，我们绝对不会透露您的个人信息。如果您有任何关于本研究的问题和看法，请及时与我们联系。联系方式为：

电话：（+852） 5168　　　　邮箱：ran.gao@

高然，香港理工大学建筑及房地产学系

第一部分：专家背景

1. 专家姓名：________________________________

2. 您所在公司的名称：________________________________

3. 您目前的职位：________________________________

4. 您所在海外工程项目的国家和地区：________________________________

5. 您在工程行业的工作经验（请点击□）：

□少于 1 年　□1-5 年　□6-10 年　□11-20 年　□超过 20 年

6. 您在海外工程的工作经验（请点击□）：

□少于 1 年　□1-5 年　□6-10 年　□11-20 年　□超过 20 年

7. 您所在海外工程项目的类型是（请点击□）：

□房建（Building）　□交通（Transportation）　□石油（Petroleum）

□电力（Power）　□工业（Industrial）　□水利（Water）

□制造业（Manufacturing）　□排水排污（Sewer/Waste）　□电信（Telecom）

□有害废物处理（Hazardous Waste）　□其他（Other），请注明：______

第二部分：我国国际承包商海外工程施工安全管理存在的问题

请您根据所在海外工程项目的实际情况，对下列安全管理问题的严重程度进行打分。本轮采用 1 至 5 的打分形式，其中 1 分表示该问题非常轻微，5 分表示该问题非常严重。

序号	施工安全管理存在的问题	打分				
P01	我国国际承包商缺乏海外工程安全管理经验	1	2	3	4	5
P02	管理层对施工安全不够重视	1	2	3	4	5
P03	安全生产责任制不清晰	1	2	3	4	5
P04	安全方案流于形式	1	2	3	4	5
P05	现场安全管理执行不力导致危险增加	1	2	3	4	5
P06	安全检查和监管薄弱	1	2	3	4	5
P07	安全投入过少	1	2	3	4	5
P08	安全管理人员配置不足	1	2	3	4	5
P09	设备、工艺及安全技术落后	1	2	3	4	5
P10	个人防护用品供应不足或质量差	1	2	3	4	5
P11	安全教育和培训不够	1	2	3	4	5
P12	外派劳工身体及心理压力大	1	2	3	4	5
P13	当地劳工安全意识差	1	2	3	4	5
P14	分包商安全管理水平低	1	2	3	4	5
P15	以包代管，总包不介入分包的安全管理	1	2	3	4	5
P16	语言障碍造成无法进行有效的安全沟通	1	2	3	4	5

第三部分：我国国际承包商在海外工程中实施安全管理的障碍

请您根据所在海外工程项目的实际情况，对下列潜在障碍的影响程度进行打分。本轮采用 1 至 5 的打分形式，其中 1 分表示该障碍的影响程度最低，5 分表示该障碍的影响程度最高。

序号	实施安全管理的障碍	打分				
D01	项目所在国与我国的社会经济发展水平不同	1	2	3	4	5
D02	项目所在国与我国的地理气候不同	1	2	3	4	5
D03	项目所在国与我国的风俗习惯不同	1	2	3	4	5
D04	项目所在国与我国的法律法规不同	1	2	3	4	5
D05	项目所在国与我国的规范标准和惯例做法不同	1	2	3	4	5
D06	项目所在国资源匮乏，安全用品供应不足	1	2	3	4	5
D07	国内对项目的后勤支持受限制	1	2	3	4	5
D08	劳工流动性大，不利于安全管理	1	2	3	4	5
D09	劳务分包众多，人员结构复杂，安全能力参差不齐	1	2	3	4	5
D10	很难提高当地工人的安全意识	1	2	3	4	5
D11	国内外派劳工长期远离祖国，很难适应工地枯燥的生活方式	1	2	3	4	5
D12	工程本身难度大（结构复杂，工期紧等）	1	2	3	4	5
D13	业主和总包的安全管理理念存在差异	1	2	3	4	5
D14	总包和分包的安全管理理念存在差异	1	2	3	4	5
D15	项目参与者之间的语言障碍不利于安全管理	1	2	3	4	5
D16	项目参与者之间的文化差异不利于安全管理	1	2	3	4	5

第四部分：我国国际承包商海外工程的安全管理措施

请您根据所在海外工程项目的实际情况，对下列安全管理措施的有效程度进行打分。本轮采用 1 至 5 的打分形式，其中 1 分表示该措施非常无效，5 分表示该措施非常有效。

序号	安全管理的措施	打分				
S01	加强领导层承诺，落实安全生产责任制	1	2	3	4	5
S02	建立和执行完善的安全管理体系	1	2	3	4	5
S03	保证安全投入	1	2	3	4	5
S04	加强工人的安全意识	1	2	3	4	5
S05	积极开展安全教育和培训	1	2	3	4	5
S06	重视设计、技术和设备安全	1	2	3	4	5
S07	对分包商进行全面的安全管理	1	2	3	4	5
S08	关注工人的身体素质和心理状态	1	2	3	4	5
S09	打造企业安全文化	1	2	3	4	5
S10	结合当地情况，制定因地制宜的安全管理制度	1	2	3	4	5
S11	重视合同，在投标阶段充分考虑安全成本	1	2	3	4	5
S12	克服语言障碍，进行及时有效的现场安全沟通	1	2	3	4	5
S13	与业主和当地监管部门进行有效的安全沟通	1	2	3	4	5
S14	保证国内总部、区域总部和项目部之间通畅的安全沟通	1	2	3	4	5
S15	考虑当地的文化、风俗习惯和宗教信仰	1	2	3	4	5
S16	雇佣当地的安全管理人员	1	2	3	4	5

问卷到此结束，感谢您的参与！

Questionnaire of the Delphi Survey: Round 2 (English Version)

A Survey of Managing Construction Safety in Chinese International Contractors' Overseas Projects (Round 2 of Delphi Survey)

Dear Madam/Sir,

Thank you very much for participating in the first round of Delphi survey. Attached is the second round questionnaire of Delphi survey. The average rates of all experts in the first round survey are given in the second round questionnaire. You are required to re-rate on all items based on a 5-point Likert scale. Please be assured that the information you provide would be kept in strict confidence and your identity would not be disclosed. Your experience and expertise would be highly valuable and your participation in this research would contribute to improving safety and health in international projects and the construction industry as a whole.

Should you have any enquiries, please feel free to contact Miss GAO Ran at +852 5168 or email to . We are looking forward to your early reply.

Yours sincerely,

Ran GAO

Construction Safety and Health Research Group

Department of Building and Real Estate

The Hong Kong Polytechnic University

Section 1: Background information

1. Your name: ________________

2. Country/ region your project located in: ________________

Section 2: Problems of construction safety management in CICs' overseas projects

To what extent do you think the following problems exist when manage construction safety in CICs' overseas projects? Please rate the following statements based on a scale from 1-5, where "1=strongly disagree" and "5=strongly agree".

S/N	Problems of construction safety management in CICs' overseas projects	Rate		
		Mean ratings	Your ratings in Round 1	Your ratings in Round 2
P01	CICs lack contracting and management experience in the project host country.	3.08	X	
P02	The top management of CICs lack commitment to construction safety.	2.68	X	
P03	Unclear responsibility for construction safety in CICs' overseas projects.	3.24	X	
P04	Health and safety plan becomes a mere formality.	2.84	X	
P05	Poor execution of safety management on site lead to potential safety hazard.	3.04	X	
P06	Inefficient safety inspection and supervision.	2.80	X	
P07	Inadequate safety budget.	3.44	X	
P08	Short of professional safety staff.	3.04	X	
P09	Backward construction safety technology and equipment.	2.92	X	
P10	Insufficient supply of PPEs in good quality.	2.68	X	
P11	Inadequate safety training and education.	2.80	X	
P12	Mental and physical fatigue of Chinese workers.	3.20	X	
P13	Weak safety awareness of local workers.	3.80	X	
P14	Low safety management ability of local subcontractors.	3.72	X	
P15	CICs lack safety control of subcontractors after contracting.	2.44	X	

S/N	Problems of construction safety management in CICs' overseas projects	Rate		
		Mean ratings	Your ratings in Round 1	Your ratings in Round 2
P16	Language barriers lead to poor safety communication.	3.08	X	

Section 3: Difficulties of implementing safety practices in CICs' overseas projects

To what extent do you think the following difficulties exist when implement safety practices in CICs' overseas projects? Please rate the following statements based on a scale from 1-5, where "1=strongly disagree" and "5=strongly agree".

S/N	Difficulties of implementing safety practices in CICs' overseas projects	Rate		
		Mean ratings	Your ratings in Round 1	Your ratings in Round 2
D01	Different socio-economic development in the project host country and China.	2.80	X	
D02	Different geographical climate in the project host country and China.	2.80	X	
D03	Different customs in the project host country and China.	2.72	X	
D04	Different laws and regulations in the project host country and China.	2.92	X	
D05	Different standards and practices in the project host country and China.	2.96	X	
D06	Shortage of materials in the project host country.	2.60	X	
D07	Limited logistic support from home office.	2.60	X	
D08	High turnover rates of frontline workers.	3.20	X	
D09	Labor-only subcontracting and complex labor structure.	3.80	X	
D10	Difficulty in changing weak safety awareness of local workers.	3.68	X	
D11	Chinese workers are far from home and cannot adapt boring lifestyle in overseas projects.	3.32	X	
D12	Tough projects (e.g. complex design, tight schedule).	2.64	X	
D13	Different safety management concepts between the developer and the main contractor.	3.20	X	

S/N	Difficulties of implementing safety practices in CICs' overseas projects	Rate		
		Mean ratings	Your ratings in Round 1	Your ratings in Round 2
D14	Different safety management concepts between the main contractor and the subcontractors.	3.20	X	
D15	Language barriers among project participants.	3.12	X	
D16	Cultural Differences among project participants.	2.92	X	

Section 4: Strategies for improving safety management in CICs' overseas projects

To what extent do you think the following strategies are useful to improve safety management in CICs' overseas projects? Please rate the following statements based on a scale from 1-5, where "1=strongly disagree" and "5=strongly agree".

S/N	Strategies for improving safety management in CICs' overseas projects	Rate		
		Mean ratings	Your ratings in Round 1	Your ratings in Round 2
S01	Deliver management commitment to safety and establish safety production responsibility system.	3.80	X	
S02	Establish and implement perfect safety management system.	3.80	X	
S03	Ensure safety budget.	4.16	X	
S04	Raise workers' safety awareness.	4.20	X	
S05	Provide safety training and education actively.	4.16	X	
S06	Pay attention to design, technology and equipment safety.	3.96	X	
S07	Manage subcontractors' safety in-depth and comprehensively.	3.88	X	
S08	Concern about workers' physical and mental state.	3.40	X	
S09	Construct safety culture.	3.64	X	
S10	Develop particular safety measures for assigned region and assigned projects.	3.80	X	
S11	Fully consider safety cost during the bidding phase.	3.76	X	
S12	Overcome language barriers to conduct effective safety communication on site.	3.60	X	
S13	Communicate with the developer and the government department on construction safety regularly.	3.56	X	

S/N	Strategies for improving safety management in CICs' overseas projects	Rate		
		Mean ratings	Your ratings in Round 1	Your ratings in Round 2
S14	Communicate with the home office and regional headquarters on construction safety regularly.	3.04	X	
S15	Consider the local culture, customs and religious belief.	3.32	X	
S16	Employ local safety management staff and professionals.	3.72	X	

Thank you for your participation.

Questionnaire of the Delphi Survey: Round 2 (Chinese Version)

关于海外工程项目施工安全管理的第二轮德尔菲调查问卷

尊敬的专家：

您好！首先，非常感谢您参与本课题的调研并认真填写了第一轮问卷。

以下内容为第二轮问卷，请根据专家平均打分和您第一轮打分，在空格处填写您的最终打分。您提供的信息将仅用于本项课题研究，我们绝不会透露您的个人信息。如果您有任何关于本研究的问题和看法，请及时与我们联系。联系方式为：

电话：（+852） 5168　　　　邮箱：ran.gao@

非常感谢您的参与和支持。祝您身体健康，工作顺利。

高然，博士研究生

香港理工大学建筑及房地产学系

第一部分：专家背景

1. 专家姓名：____________
2. 海外工程项目的国家和地区：__________________

第二部分：我国国际承包商海外工程施工安全管理存在的问题

请您根据所在海外工程项目的实际情况，对下列安全管理问题的严重程度进行打分。本轮采用 1 至 5 的打分形式，其中 1 分表示该问题非常轻微，5 分表示该问题非常严重。

序号	施工安全管理存在的问题	打分		
		专家平均分	您的第一轮打分	您的第二轮打分
P01	我国国际承包商缺乏海外工程安全管理经验	3.08	X	
P02	管理层对施工安全不够重视	2.68	X	
P03	安全生产责任制不清晰	3.24	X	
P04	安全方案流于形式	2.84	X	
P05	现场安全管理执行不力导致危险增加	3.04	X	
P06	安全检查和监管薄弱	2.80	X	
P07	安全投入过少	3.44	X	
P08	安全管理人员配置不足	3.04	X	
P09	设备、工艺及安全技术落后	2.92	X	
P10	个人防护用品供应不足或质量差	2.68	X	
P11	安全教育和培训不够	2.80	X	
P12	外派劳工身体及心理压力大	3.20	X	
P13	当地劳工安全意识差	3.80	X	
P14	分包商安全管理水平低	3.72	X	
P15	以包代管，总包不介入分包的安全管理	2.44	X	
P16	语言障碍造成无法进行有效的安全沟通	3.08	X	

第三部分：我国国际承包商在海外工程中实施安全管理的障碍

请您根据所在海外工程项目的实际情况，对下列潜在障碍的影响程度进行打分。本轮采用 1 至 5 的打分形式，其中 1 分表示该障碍的影响程度最低，5 分表示该障碍的影响程度最高。

序号	实施安全管理的障碍	打分		
		专家平均分	您的第一轮打分	您的第二轮打分
D01	项目所在国与我国的社会经济发展水平不同	2.80	X	
D02	项目所在国与我国的地理气候不同	2.80	X	
D03	项目所在国与我国的风俗习惯不同	2.72	X	
D04	项目所在国与我国的法律法规不同	2.92	X	
D05	项目所在国与我国的规范标准和惯例做法不同	2.96	X	
D06	项目所在国资源匮乏，安全用品供应不足	2.60	X	
D07	国内对项目的后勤支持受限制	2.60	X	
D08	劳工流动性大，不利于安全管理	3.20	X	
D09	劳务分包众多，人员结构复杂，安全能力参差不齐	3.80	X	
D10	很难提高当地工人的安全意识	3.68	X	
D11	国内外派劳工长期远离祖国，很难适应工地枯燥的生活方式	3.32	X	
D12	工程本身难度大（结构复杂，工期紧等）	2.64	X	
D13	业主和总包的安全管理理念存在差异	3.20	X	
D14	总包和分包的安全管理理念存在差异	3.20	X	
D15	项目参与者之间的语言障碍不利于安全管理	3.12	X	
D16	项目参与者之间的文化差异不利于安全管理	2.92	X	

第四部分：我国国际承包商海外工程的安全管理措施

请您根据所在海外工程项目的实际情况，对下列安全管理措施的有效程度进行打分。本轮采用 1 至 5 的打分形式，其中 1 分表示该措施非常无效，5 分表示该措施非常有效。

序号	安全管理的措施	打分		
		专家平均分	您的第一轮打分	您的第二轮打分
S01	加强领导层承诺，落实安全生产责任制	3.80	X	
S02	建立和执行完善的安全管理体系	3.80	X	
S03	保证安全投入	4.16	X	
S04	加强工人的安全意识	4.20	X	
S05	积极开展安全教育和培训	4.16	X	
S06	重视设计、技术和设备安全	3.96	X	
S07	对分包商进行全面的安全管理	3.88	X	
S08	关注工人的身体素质和心理状态	3.40	X	
S09	打造企业安全文化	3.64	X	
S10	结合当地情况，制定因地制宜的安全管理制度	3.80	X	
S11	重视合同，在投标阶段充分考虑安全成本	3.76	X	
S12	克服语言障碍，进行及时有效的现场安全沟通	3.60	X	
S13	与业主和当地监管部门进行有效的安全沟通	3.56	X	
S14	保证国内总部、区域总部和项目部之间通畅的安全沟通	3.04	X	
S15	考虑当地的文化、风俗习惯和宗教信仰	3.32	X	
S16	雇佣当地的安全管理人员	3.72	X	

问卷到此结束，感谢您的参与！

APPENDIX D: RESEARCH INTERVIEW REPORTS

Research Interview Report A

Interviewees: Interviewee A

Date: 14th May 2014

Time: 8:00 pm to 9:00 pm

1. Please introduce your project(s) generally, e.g. project type, contract type, contract value, duration, contract conditions (safety budget in the BOQ, contract terms regarding safety, e.g. safety procedures, health and safety for staff and labor), safety management system.

The project is a Satellite City Developing Project in Luanda, Angola. The contract type is Engineer-Procure-Construct project using FIDIC contract conditions, and the value is USD 3.5 billion. The owners are Angola government and SONANGOL. The consultant is from Portugal. It started from 2008 and the initial duration was 40 months, which varied to 60 months gradually. All the subcontractors (more than ten) were from China and the number of workers was 20,000 at peak, including 15,000 Chinese workers and 5,000 Angola workers. To be clarified, this project was our first large project in Angola, and it was a complete mess at the beginning. Most of the materials relied on importing from China, and we jointly operated supporting factories with local government to supply sand, stone and blocks subsequently. The local workers have different cultures with Chinese workers and they are not willing to work overtime. For example, they would leave the uncompleted concrete in the mixer once the closing time is coming. Due to a lack of management experiences, we did not employ many Angola workers at the beginning. But for current projects in Angola, the ration of local workers could be as high as 75%. We withheld subcontractor 2% to 2.5% of the subcontract value for the safety budget. For the main contractor, project manager is the first responsible person, and the Safety and

Security Department is set up to manage construction safety as well as to maintain the public order. For the subcontractors, their managers are also responsible for construction safety, and a specified safety liaison is in charge of the construction safety and public order in his company. We use the project-based safety management standard in our project, which is derived from China Railway, one of our subcontractors' domestic standard. Although the headquarters sets an enterprise standard, it is difficult to be implemented in different countries. In our project, the Chinese workers are mainly employed by subcontractors through labor agency and the Angola workers mainly get their jobs by friends' referral. The Chinese workers usually sign a two-year contract at the beginning and over half of them are willing to work longer. In some Southern American countries, Chinese labors are forbidden to be imported.

2. What are the main safety and health problems in Chinese international contractors' overseas projects?

Local workers seldom vaccinate and they may die on site due to infectious diseases such as malarial fewer. The consultant and government will then investigate the accidents and question the food and accommodation. Actually, the infectious diseases are not caused by project and they are common to see among Angola people. In addition, the local workers tend to have intemperate life style, which is harmful to health. Most of the fatalities for local workers are because of traffic accidents.

Although our project is not technologically advanced, there are still some fatalities. During the first two years of the projects, no fatality accident happened among Chinese workers. However, there were four fatalities happened during the following two years. One of them is that a Chinese worker took rest just below the tower crane basket full of blocks and then was killed by the blocks slipped off the basket. Actually, everybody knows it is very dangerous to stay below the basket. But why did he stay there? It is because of mental fatigue. The long-term boring life out of their home country makes workers mind numbing.

Once the fatalities happened, they were reported to the consultant, owner and the government. The Chinese workers' fatalities were also reported to Chinese Embassy in Angola. There are no safety regulations or laws in Angola. The subcontractor will be punished to stop for rectification. Insurance was bought for the project. We usually compensated the workers ourselves and then claimed from the insurance company. Compared with those of Chinese workers, both average salary and fatality compensation amount for local workers are discriminatory.

Our company has established a training school in Angola to teach construction skills to local workers. They worked as general labors ago but now they can work as skilled ones. The Chinese workers are skilled workers before they come to Angola.

Security is a big problem in our project. Two workers were shot dead by local robbers in the camp.

3. What are the measures of safety management in Chinese international contractors' overseas projects? Any difficulties to implement these measures?

The main contractor withholds the safety budget and carries out centralized purchase of safety materials such as safety nettings and PPEs from China. To reduce expenses, the subcontractors may request less safety materials, so main contractor's safety inspections are quite important. Safety training is mandatory for all Chinese workers and safety responsibility contracts are signed before workers start to work. Punishments are imposed to subcontractors for unsafe behaviors. However, sometimes the implementation is not that rigorous due to tight schedules.

We use interpreters during local workers' safety training. However, inadequate safety trainings are conducted for local workers. Only local foremen are trained and they are required to ensure safety for their own teams (varied from 10 to 50 local workers). The local workers are usually unskilled and introduced by a particular foreman. They learn skills from Chinese workers on site, but there is seldom safety communication between Chinese workers and local workers. Safety notices are presented in both Chinese and Portuguese with graphic information, so all workers can understand the information on them. Toolbox talks are conducted to all workers on site.

4. Would you please give some recommendations for improving safety management in Chinese international contractors' overseas projects?

One suggestion is to improve Chinese workers' quality of life. A majority of Chinese workers working on our site prefer to work overtime to earn more money. Actually, most of the Chinese workers suffer spirits exhaustion due to hard work and boring life overseas, and this may affect their safety performance.

5. What are the factors affecting safety management level among international projects?

Factors affecting safety management level among international projects includes: i) owner and consultant's requirements, ii) main contractor's positioning strategy in a particular country, which can affect their safety attitude and safety input for a particular project. As far as I know, in Angola, some Brazilian and Portuguese contractors do better in safety management of local workers.

6. What are the percentage of Chinese workers, local workers and workers from third countries in the frontline workers? What construction trades do they join each?

The ration of local workers could be as high as 75% in some of our projects. Most of the Chinese workers are skilled labors. After training, nearly half of the local workers can do technical works.

7. Do you think nationalities, religions and employment ways could affect workers' safety performance?

I have no idea of whether religions could affect workers' safety performance. As for nationalities and employment ways, they could definitely affect workers' safety performance. We generally do not select during the recruitment of local staff, and it is unfavorable to safety management. Angolan workers are more willing to comply with safety rules than Chinese workers.

8. Other remarks:

Although local workers have enjoyed better living conditions on site than in their home, the accommodation conditions for local workers are still worse than those for Chinese in my project.

Research Interview Report B

Interviewees: Interviewee B

Date: 16th May 2014

Time: 2:30 pm to 3:30 pm

1. Please introduce your project(s) generally, e.g. project type, contract type, contract value, duration, contract conditions (safety budget in the BOQ, contract terms regarding safety, e.g. safety procedures, health and safety for staff and labor), safety management system.

The project is residential and commercial mixed building project. Contract type is design-build project using FIDIC contract conditions. The contract value is USD 440 million. It started from April 2009 and the initial duration was 32 months, which has varied to 74 months due to economic depression. Fixed safety budget is regulated in the BOQ, with a description of general safety requirements. Contract terms are limited to FIDIC general conditions. The HSE management systems of the whole company are OHSAS 18001: 2007 and ISO 14001: 2004. However, the implementation of the management systems in a particular project is deficient. Many management staff and workers even do not know the existence of the systems. The head office should have issued standard guidelines to the branches office, but the person who is responsible to receive this kind of documents may be not professional in safety and then ignore the documents. Actually, as far as I know, the standard guidelines for safety have never been issued to the project level.

In my opinion, the standards for construction safety in international projects could be diverse, and local social and economic environment would affect these standards to some extent. For example, some undeveloped countries may never have safety regulations and laws, so the company domestic standards naturally become the project standards. There are different stories in some emerging economics or developed countries. In our project in Abu Dhabi, we apply British safety standards, which are higher than our company domestic standards.

Compared to the guidance from head office, strict supervision from local government, owner and consultant is more effective to improve safety management level for the whole project.

2. What are the main safety and health problems in Chinese international contractors' overseas projects?

First of all, the safety management systems are not integrated and their execution is bad. Secondly, the safety culture in our project is quite poor. The frontline workers may know nothing except safety awards and safety penalty. They are unwilling to wear personal protective equipment due to the low quality and uncomfortableness of equipment and hot weather. Safety input is not enough and safety may be ignored due to tight schedule. Many plants and equipment are quite old and repair of them is not enough. Safety trainings to the frontline workers and administrative staff are not enough. The routine participation of the senior management is not enough and what they think is just no accident. The workers tend to have weak safety consciousness, and they may trust luck that the unsafety conditions will not lead to accidents on themselves. Although the safety schemes are put forward, they are often left on the shelf on site. Compared with the safety communication barriers between safety staff and workers due to language barriers, the barriers between safety staff and foremen are even more serious, mainly because of the weak safety consciousness of the foremen. Many foremen are averse to high safety standards themselves, not to mention implement them to the workers. I think the workers are relatively simple to management and the safety reward and punishment schemes are quite useful.

There are three serious accidents in this project. The first accident is a foreign worker dropped down from a hole and got wounded due to the unprotected hole. The second accident is a Chinese worker hurt by concrete pump when he tried to clean the pump by air compressor. The root reason for the second accident is that the backward construction method. Using air compressor to clean concrete pump is obviously deemed to be danger and cannot meet the safety requirements. The third accident occurred right after the stalling period. Because of inadequate staffing and slack supervision for site management, a foreign worker was killed due to falling from tube well.

The main contractor and subcontractor are responsible for accident compensation according to a certain proportion. The accident has to be reported to the employer, the local government and corporation headquarters in China. If a Chinese worker is involved in a fatal accident, it has to be reported to Chinese embassy as well. Which is different from domestic projects, the accidents are seldom concealed in overseas project.

3. What are the measures of safety management in Chinese international contractors' overseas projects? Any difficulties to implement these measures?

The measures of safety management in overseas project is quite similar to domestic project, which include technical measures, engineering measures, personal protection, administrative and legal measures.

The difficulties to implement safety measures include backward technologies and knowledge, inadequate safety staffing, tight schedules, foremen and workers' ignoring safety scheme, insufficient safety investment, and workers are unwilling to wear personal protective equipment due to bad quality of PPEs.

The management staff are mainly Chinese and the rest are foreigners with adequate English language ability, so there are no language barriers to safety communication between management staff. The language barriers between management staff and frontline workers will distinctly affect the work efficiency and progress. The safety notices are only in English and Chinese at the moment, and notices in other languages have yet to be set up. During the progress of project localization, many non-Chinese workers are substituted for Chinese ones, leading a relatively high turnover rate and adverse effect to safety management. In addition, the increase of foreign workers brings cultural conflicts and language barriers, which may cause fights among them.

4. Would you please give some recommendations for improving safety management in Chinese international contractors' overseas projects?

First point, the senior management should increase attention to safety participation and execution, more than shouting slogans. Secondly, more unified safety trainings should be conducted to enhance safety awareness of workers and to overcome cultural conflicts. Third point is to strengthen the construction of enterprise safety culture from the headquarters. Fourth point is to increase safety input and promote advanced and safer technologies. Compared with the European and American contractors, our equipment is backward with low efficiency and safety. Last, safety management system should be implemented effectively to promote standardized safety management and information sharing.

5. What are the factors affecting safety management level among international projects?

The first factor is technology level. Low technology level and poor quality of construction equipment would definitely lead to bad safety management level. The second factor is workers' working experience and skilled level. The third factor is language barriers between management staff and frontline workers. The forth factor is the holistic management level of the construction company. Some Chinese state-owned construction enterprises are not well institutionalized and prone to be not acclimated to overseas projects. For example, in some occasions, the company standards, local standards, and project standards may conflict and lead to confusion in management. The fifth factor is the uneven safety management level of the subcontractors.

6. What are the percentage of Chinese workers, local workers and workers from third countries in the frontline workers? What construction trades do they join each?

Chinese workers account for 2%-3%, and the rest are foreign workers. Indian and Bangladesh workers are vast majority while Pakistan and Vietnam workers account for a small percentage. Chinese workers mainly engage in work with high technological content or work as foremen. A few foreign workers who have adequate working experience and capacity in our company can also work as foremen. Workers holding same nationality are arranged working in different groups rather than working in the same group(s). Therefore, workers from a particular group are from different countries and speak different languages. Due to language barriers, safety communication is often carried out by body languages, leading to repeated communication and low efficiency. The foreign workers are general labors at the beginning and learn new skills during work.

7. Do you think nationalities, religions and employment ways could affect workers' safety performance?

Nationality could affect safety performance. First of all, the workers would form small cliques according to their nationalities, and different cliques are competing in either productivity or safety behaviors. Therefore, right guidance can increase the workers' safety performance. Secondly, the workers' safety performance level is in proportion to socioeconomic level of their original nations. Thirdly, non-Chinese workers are generally more obedient than Chinese workers. The reason may be Chinese workers have superiority because of their skills and good personal relationship with Chinese foremen, and they realize that they cannot be fired even when they do wrong. By contrast, foreign workers usually strictly abide by the company regulations as they are afraid to lose the job if they make mistakes.

Religion does not affect safety performance essentially. However, as we work in a Muslim country, the compensation amount for a Muslim worker is higher than a non-Muslim worker when the same accident occurs.

Recruitment type will seriously affect the safety performance. At present, the recruitment process emphasizes more on workers' skills and ignores their safety awareness. Compared with the our directly employed workers, workers from labor subcontractors are sometimes without recruitment selection, and they may have bad physical condition and are prone to suffer sudden diseases (e.g. heart attack) and chronic occupational diseases (e.g. backache).

8. Other remarks:

No.

Research Interview Report C

Interviewees: Interviewee C

Date: 4th June 2014

Time: 2:00 pm to 3:00 pm

1. Please introduce your project(s) generally, e.g. project type, contract type, contract value, duration, contract conditions (safety budget in the BOQ, contract terms regarding safety, e.g. safety procedures, health and safety for staff and labor), safety management system.

It is a thermal power station project that locates in Vietnam. The contract type is Engineer-Procure-Construct project using FIDIC contract conditions, and the value is nearly RMB 10 billion. It started from 2010 and the initial duration was more than 4 years. The main contract conditions have not stipulated safety budget or any detailed safety requirements. In the subcontracts, we stipulate rather detailed safety standards and safety requirements, and remain 2% of the construction cost of subcontract works as safety fees. This proportion comes from the domestic regulations issued by Chinese Ministry of Finance and State Administration of Work Safety. We assess subcontractors' actual safety input and their safety performance, and pay their safety fees in full or in part. We have a unified safety management system in the company level. We apply this system with minor amendment after considering the actual situation in the particular project.

Due to less developed society and economy of the host country, the employer and engineer do not set strict demands on construction safety. The company safety standards are even more superior to local government laws and regulations. Since all international projects contracted by our company are located in non-developed third world countries (e.g. Southeast Asia, the Middle East, Africa etc.), company safety standards could not be met due to the backwardness in some host countries, and we have already lowered our standards in some projects.

Because of cultural differences, local workers are not willing to work overtime as Chinese workers, and most of them have poor skills. They are working as general labors or trades with low skillful requirements. We rely on Chinese workers for high technical works. The conditions of subcontracts vary between Chinese subcontractors and local subcontractors, and we usually lower the safety standards to local subcontractors. For example, we once required all subcontractors to conduct hazard identification, but local ones could not carry out it at all, and they even failed to understand why to do it. Finally, we omitted this requirement as it was relatively less important than some other requirements, and only insisted on the most crucial ones.

2. What are the main safety and health problems in Chinese international contractors' overseas projects?

The local workers' safety awareness is far behind Chinese workers', and many of them lack basic safety knowledge. As the weather in Vietnam is quite hot, many local workers prefer to wear shorts and T-shirts on site, and many of them even do not wear shoes at all. We have made a great deal of efforts to change these, and we even give them shoes for free. However, many local workers are still barefoot on site because they think it is more comfortable to not wear shoes. Meanwhile, in order to work conveniently, many local workers also do not wear other PPEs. This bad working habit is really difficult to correct. Compared with local workers, Chinese workers usually take safety actions after balancing the convenient and safety. Another point to be mentioned is the huge difference of fatal compensation fee, which could reflect that local workers do not value safety enough to some extent. Fatal accident compensation fee for Chinese worker is ten times the amount of their Vietnam peers, while the wage gap is not that huge. Safety inputs from local subcontractors are very low, and they do everything possible to reduce safety cost. You cannot imagine that they use waste formwork to make electric boxes.

Chinese workers have some safety consciousness and easier to accept safety management. And they generally do not feel isolation in Vietnam, as the climate and people appearance here are quite similar to China. An old worker in our project ever said that he worked in overseas projects all his life and Vietnam was the only country he could not feel that he was living abroad. The accommodation conditions for workers are quite good, and we also supply entertainment and sports facilities to the workers. Vietnam workers live separately with Chinese workers.

We buy project-based insurance such as construction all risks, and we also ask the subcontractors to buy accidental injury insurance for their workers. No serious accident has occurred in our project till now.

3. What are the measures of safety management in Chinese international contractors' overseas projects? Any difficulties to implement these measures?

Economic measures, including safety reward and safety punishment.

Regulating safety requirements in the contract, which is quite different from domestic projects. As I observed, most domestic projects disobey the contracts although they do exist. We normally follow contract requirements in overseas project.

Executing effective supervision of safety management on site.

Conducting safety trainings. The induction trainings are compulsory for all workers and they can only get entrance permissions after completing the training. We, the main contractor supervises the safety trainings rather than conduct them ourselves. As safety trainings are conducted by subcontractors' safety officers who are normally local, no language barriers exist during the trainings. Safety meetings are hold among management staff of main contractors and subcontractors in English, and all management staff from subcontractors has adequate English language ability. Safety notices are in Chinese, Vietnamese and English.

The difficulties are mainly poor implementation and supervision on site. Safety inputs of local subcontractors are inadequate. Actually, safety performance level of Chinese subcontractors in our project may be also not as good as they did in Chinese domestic projects. Because of higher risks and uncontrollable factors in international projects, same amount of safety input produces different level of safety output.

4. Would you please give some recommendations for improving safety management in Chinese international contractors' overseas projects?

It needs long-term efforts to enhance workers' safety consciousness. We should continuously improve safety management level.

Increasing safety input is crucial. To guarantee profits, we should consider safety budget from tender stage. The owner, engineer and contractor should be responsible for project safety all together, rather than contractor shoulders responsibility itself.

Using experienced safety management personnel in overseas projects.

To fulfill human resource localization in overseas project, as using local safety management and local workers can avoid culture conflicts and language barriers.

5. What are the factors affecting safety management level among international projects?

Social and economic development level of workers' original countries could affect workers' safety awareness.

Safety communication level is another important affecting factor. Language barriers cause inefficient communication. To mitigate the barrier, body languages and interpreters are used in overseas project, which could lead to wrong information transmission. Actually, it is very important to reduce communication range, that is to say, we mainly conduct safety communication with local management staff that has adequate English language ability, and then they transmit safety information to the frontline workers. There is a principle that to increase safety communication between local people and to reduce that between local people and Chinese staff. I would like to give you an example. If I am a safety staff from the main contractor and there are ten local workers and no local safety officer from the subcontractor, I have to transfer safety information to them ten and I cannot make sure they understand me because I do not think they understand English quite well. But if there is a local safety officer from the subcontractor, I should only transfer the safety information to him, who can understand me totally as he is good at English, and then he will transfer the information to his workers in native language, all ten workers shall understand the safety information then.

6. What are the percentage of Chinese workers, local workers and workers from third countries in the frontline workers? What construction trades do they join each?

The ration of local workers could be as high as 75% to 80%. Wages of Chinese workers are almost three to four times of wages of Vietnamese. Chinese workers usually join trades need more skills, while local workers join the others.

7. Do you think nationalities, religions and employment ways could affect workers' safety performance?

Nationality could influence safety performance. Chinese workers have better safety performance than their local peers. Religions' effect to safety performance is not obvious. I do not think employment ways could affect workers' safety performance.

8. Other remarks:

No.

Research Interview Report D

Interviewees: Interviewee D

Date: 15th June 2014

Time: 2:00 pm to 3:00 pm

1. Please introduce your project(s) generally, e.g. project type, contract type, contract value, duration, contract conditions (safety budget in the BOQ, contract terms regarding safety, e.g. safety procedures, health and safety for staff and labor), safety management system.

We are the nominated subcontractor of facade work for Phase of Galaxy Macau, the total amount for the subcontract is RMB 0.38 billion and the duration is 22 months. The main contract is Hsin Chong Construction Group from Hong Kong. There are three safety personnel from the owner and nine from the main contractor for the whole project. For the façade work, we, the subcontractor provides three safety personnel and two safety officers from the main contractor specialize in our subcontract work. Generally speaking, safety staffing is quite adequate. The safety officers from main contractor conduct daily routine check, judge the risk level and provide us with safety violation and safety punishment, and I think their safety management is effective and safety communication is clear and open. However, the punishment amount is too huge for the workers to accept. A fine for not wearing PPEs could be as high as a worker's monthly wages or even higher, which cause workers' resistance to high risk works and may reduce work productivity.

After the main contractor has conducted induction training, we also conduct two-hour induction training for our part of work. We use written materials, slides and demonstrations to train workers.

Generally speaking, safety management for the current project in Macau is better than that in UAE projects. Although the projects in UAE showed high safety standards and safety requirements in written specifications, the implementation of them was barely satisfactory. I have met owners from various countries such as Syria, Egypt, Jordan and China. Compared with foreign contractors, Chinese contractors are easier to communicate with as we have the same culture background and no language barriers. Although the foreign contractors apply higher safety standards than Chinese contractors, the implementation is not as expected. We do have culture conflicts and language barriers with foreign contractors. For example, I think foreign contractors pay too much attention to details, and they stop working for rectification immediately after they discover any violation, but they never impose a fine. By contrast, Chinese contractors emphasize productivity, so they just impose fines for the safety violation and seldom stop subcontractor working. I prefer the Chinese contractor style.

Most of the workers are from Mainland China, and they are antipathetic to some of the safety regulations from the Hong Kong main contractor, e.g. huge amount of safety fine.

2. What are the main safety and health problems in Chinese international contractors' overseas projects?

In UAE, due to unfamiliar environment, harsh climate, distasteful food supply, bad accommodation conditions and lack of entertainment, many Chinese workers suffer severe depression and mental fatigue. This bad emotional and mental condition enlarges safety risks. One time in my project there were over ten Chinese workers called in sick in the same day. What's worse, some sick workers force themselves to work for gaining daily wages, which highly threat safety management on site. This problem is not common to see in Macao.

In UAE, we apply the same safety requirements to foreign workers. We fulfill safety trainings to them through interpreter. We seldom arrange them dangerous work, but mainly general labors. The foremen are mainly Chinese, so there are some language barriers between foremen and workers. Lots of body languages and sketch maps are used for communication. The living conditions for foreign workers are neither good, and they live in a different camp not from the Chinese workers'.

As the safety punishment is too strict in Macau project, many Chinese workers are antipathetic to safety management.

I think our company insufficiently takes seriously of the safety management to overseas projects. Although the headquarters has issued safety guidelines for all projects, they are mainly implemented in domestic projects. As overseas markets are deemed to be unstable and unsustainable, investment of advanced plants is not large-scale.

There were some accidents such as hand injuries; however, no fatal accident happened in our project. We buy accidental injury insurance for our workers.

3. What are the measures of safety management in Chinese international contractors' overseas projects? Any difficulties to implement these measures?

a. Making practical preparation for emergency accident.

b. Applying innovative and advanced technologies to improve the safety management.

However, the contractor could not accept these technologies easily, and we have to demonstrate and prove the feasibility to them.

4. Would you please give some recommendations for improving safety management in Chinese international contractors' overseas projects?

Allocate sufficient safety staffing.

Enhance management commitment in overseas project. I think the support from senior management is crucial to successful safety management.

To increase safety investment

Employ Chinese safety officers. Both Chinese and foreign safety officers have ever been employed among JH's overseas projects, and each of them have their pros and cons. A foreign safety officer is more proficient to local safety rules and regulations and usually implements them strictly. However, Chinese workers may think he is too inflexible due to culture differences. If Chinese workers account for majority in an overseas project, it is better to employ Chinese safety officers rather than foreign ones to avert culture conflicts.

The corporate headquarters should take seriously of overseas projects. A third of JH's total projects are overseas projects now. It is urgent to manage them systematically and scientifically.

5. What are the factors affecting safety management level among international projects?

Professional Chinese safety staff should be trained for overseas projects, as safety management practices of Chinese domestic projects are quite different from international ones.

Organizational structure, organizational culture and management level of the company could affect safety management. We have to move towards internationalization gradually.

6. What are the percentage of Chinese workers, local workers and workers from third countries in the frontline workers? What construction trades do they join each?

Actually, we would like to use all Chinese workers in UAE projects. However, local government limits the import quota and we have to employ a few foreign workers if in need. In Macau, all workers are Chinese.

7. Do you think nationalities, religions and employment ways could affect workers' safety performance?

Nationalities could affect workers' safety performance. In UAE projects, some Chinese workers violate safety regulations due to masculinity, and claim that they are experienced in China. By contrast, because foreign workers know they lack working experience, they are more obedient to safety regulations and take safety seriously.

Employment ways could affect workers' safety performance. Safety performance of directly employed workers is better than that of workers from labor subcontractors.

I do not think religions affect workers' safety performance.

8. Other remarks:

No.

Research Interview Report E

Interviewees: Interviewee E

Date: 6th June 2014

Time: 5:00 pm to 6:00 pm

1. Please introduce your project(s) generally, e.g. project type, contract type, contract value, duration, contract conditions (safety budget in the BOQ, contract terms regarding safety, e.g. safety procedures, health and safety for staff and labor), safety management system.

The project is composed of 16 buildings at King Khaled University at Abha, Saudi Arabia. The contract type is Engineer-Procure-Construct project using FIDIC contract conditions, and the value is USD 0.612 billion. It started from July 2008 and the initial duration was 3 years, which varied to 5 years gradually. The client is Saudi Arabia Ministry of Higher Education. The consultant is an Egyptian company. Actually, it is the first project that Chinese contractors perform as a main contractor in Saudi Arabia after the signing of bilateral memorandum of understanding on engineering project cooperation. In the past, Chinese construction enterprises could only be engaged in business in Saudi Arabia as subcontractors, and the signing of this memorandum will offer them the rights as direct bidders in projects under the Ministry of Municipal and Rural Affairs such as roads, bridges and buildings. So the Chinese government gave great support to the project, and the political benefit was obviously more important than its economic benefit. It did not stipulate detailed safety management requirements in the contract conditions, and the main contractor conducted self-management for the construction safety. Local policies regarding medical care are quite advanced. The safety management system was quite specific for the particular project, which was proposed by the main contractor and approved by the consultant.

2. What are the main safety and health problems in Chinese international contractors' overseas projects?

General safety guidelines are published by our domestic headquarters based on Chinese domestic construction industry experience, such as safety education plan, requirements of working high and other regulations. For a specific project, safety standards are established from the company guidelines, as well as the requirements from the owners, the engineers and host country's laws. Specific subcontractors were mainly local and Chinese subcontractors were usually labor subcontractors.

First of all, the social and political environment of our project's host country is stable, so security is not a problem here. Secondly, workers' eating habit can affect workers' physical condition, thereby affect construction safety. For example, one foreign worker in our project fell from heights due to dietary deficiency. This becomes a common problem for Muslim workers during Ramadan. Thirdly, although the living conditions for Chinese workers are quite comfortable, the lack of entertainment would cause their mental fatigue. To mitigate this problem, we organized sport events regularly. There were some accidents such as hand injuries; however, no fatal accident happened in our project.

3. What are the measures of safety management in Chinese international contractors' overseas projects? Any difficulties to implement these measures?

First of all, the safety education to workers as well as to management staff, including induction training and daily toolbox meeting, is quite important. We conduct safety training to Chinese workers and foreign workers together, and the training is translated to English and explained to foreign workers by interpreter. I think most of our foreign workers could understand simple English. Safety notices were mainly written in English and Arabic, and seldom were in Chinese, so the safety notices hardly worked to Chinese workers. Secondly, specific safety measures were given out in written documents, which created a safety standard to follow. Last, we employed local staff for public relation work to reduce the influence of public order accident.

The difficulties are bad implementation of the safety measures and inadequate supervision on site.

4. Would you please give some recommendations for improving safety management in Chinese international contractors' overseas projects?

The most important thing is to establish a complete emergency plan to cope with any potential safety risks, such as political risks, security risks and construction safety risks, and to mitigate consequential adverse effects. Take our project as an example, we provided a full-time ambulance with us for potential accidents, and our first-aid room always prepared blood serum for snakebites.

5. What are the factors affecting safety management level among international projects?

The affecting factors include management commitment, safety education and specific safety measures. Safety incentive and safety punishment could also enhance safety management level.

6. What are the percentage of Chinese workers, local workers and workers from third countries in the frontline workers? What construction trades do they join each?

At the beginning, we tried to employ local labor subcontractors of which the workers were mainly Indian and Pakistani. However, the work productivity was very unsatisfactory and we began to substitute Chinese labor subcontractors for them to speed up construction and meet duration deadline. Chinese workers are comparatively willing to work overtime for high wages. At the peak of our project, Chinese workers accounted for more than 90%. After completed the structure work, installation work was mainly awarded to local subcontractors and their workers were from various countries including India, Pakistan, Philippines, and Bangladesh and so on. It required more efforts on safety management then. However, as long as the supervision is adequate, I do not think language barrier is an insurmountable problem.

7. Do you think nationalities, religions and employment ways could affect workers' safety performance?

I think religions could affect workers' safety performance. Different religions share different views on death. Some religions could confront death more calmly than others and this is averse to workers' safety performance.

Safety performance levels of foreign workers from different countries in our project were approximately the same. However, Chinese workers performed higher safety performance level than the foreign ones. I do think a worker's safety consciousness is in proportion to the economic development level of his original country.

The directly employed workers have better safety performance. The labor subcontractors, especially small ones, often delayed payment to workers and their workers' wages and welfares could not be guaranteed. Due to bad food and accommodation conditions, these workers were usually in bad physical conditions. For example, one foreign worker in our project fell from heights due to dietary deficiency.

8. Other remarks:

No.

Research Interview Report F

Interviewees: Interviewee F

Date: 11th June 2014

Time: 1:30 am to 2:30 am

1. Please introduce your project(s) generally, e.g. project type, contract type, contract value, duration, contract conditions (safety budget in the BOQ, contract terms regarding safety, e.g. safety procedures, health and safety for staff and labor), safety management system.

The project is International Conference Center in Algiers, Algeria. The contract type is Engineer-Procure-Construct project and the value is USD 800 million. It started from April 2011 and the initial duration was 31 months, which varied to 42 months. The owner is Algerian government and the consultant is an Italian company. There is no specific safety budget mentioned in the main contract or subcontracts, only included in the comprehensive unit price. There are also some basic safety regulations such as site access and safety violation. We require the subcontractor to assign a safety staff to take safety responsibility. The HSE management systems are OHSAS 18001: 2001 and ISO 14001: 2004. Although there are no unified safety guidelines for international projects among different countries and branches, we have a unified set of safety management documents in Algeria branch, which have been applied to all projects here.

2. What are the main safety and health problems in Chinese international contractors' overseas projects?

The most important safety management problem in Algeria is emergency response. Although we have on site first-aid equipment, if the injury is heavier, the injured worker could not receive timely and effective medical care due to local backward medical facilities. The second point is the local government does not attach great importance to construction safety, and I think this is mainly because of the social and economic development in Algeria. The safety management mainly relies on main contractor's self-management. Some Chinese international contractors do not pay much attention to the self-management, and they may reduce safety input in international projects. Thirdly, due to labor shortage in Chinese construction industry, many Chinese workers working in our project are unskilled. They are barbers and cooks in china and work as construction workers in Algeria. They have relatively weak safety awareness. The local workers' safety awareness is even weaker, and local subcontractors do not pay much attention to safety training and management.

An accident case is a Chinese worker was killed by objects falling from the mobile crane because of plant operator's wrong operation. The plant operator is a local worker and has worked with us for a long time. Because special license for mobile crane is not applicable in Algeria, the worker has only local driving license, and the training for mobile crane may be not professional enough. In addition, this accident happened during Ramadan. The plant operator fasted and did not keep fine physiological status in the afternoon, which was also a potential reason for the accident.

3. What are the measures of safety management in Chinese international contractors' overseas projects? Any difficulties to implement these measures?

No.

4. Would you please give some recommendations for improving safety management in Chinese international contractors' overseas projects?

No.

5. What are the factors affecting safety management level among international projects?

Factors affecting safety management level include: i) contractor's quality and management level, ii) local social and economic development level, iii) government intervention.

Although supervision is important to safety management, the supervision implementation is hindered by local social environment.

6. What are the percentage of Chinese workers, local workers and workers from third countries in the frontline workers? What construction trades do they join each?

For the current project, due to tight schedule and heavy task, the owner requires us to use Chinese workforce, so most of the frontline workers are Chinese, and only the material suppliers and specialists are from Europe. However, in some other projects, we use both Chinese labors and local labors, and the ratio of Chinese workers to local workers is around 1 to 1. The Chinese workers are skilled labors while the local workers are generally unskilled ones, and they work mixedly. Recently, we are making efforts to train local workers skills to fulfill labor localization.

7. Do you think nationalities, religions and employment ways could affect workers' safety performance?

Nationalities can affect workers' safety performance due to unequal development of society and economy.

I do not think religions affect workers' safety performance in our projects.

Employment ways could affect workers' safety performance. As for local workers, safety performance of workers from local labor subcontractors is better than that of directly employed ones.

8. Other remarks:

No.

Research Interview Report G

Interviewees: Interviewee G

Date: 11th June 2014

Time: 5:00 pm to 6:00 pm

1. Please introduce your project(s) generally, e.g. project type, contract type, contract value, duration, contract conditions (safety budget in the BOQ, contract terms regarding safety, e.g. safety procedures, health and safety for staff and labor), safety management system.

The current commercial building project started in 2011 and the duration is 43 months (6 months for design and 37 months for construction). The employer is CapitaLand, a Singapore developer. The contract type is Engineering-Procurement-Construction project and the contract value is USD 121 million (excluding tax). We reserve a budget around USD 1.5 million for safety related works, accounting for over 1% of the total contract value. The contract conditions specify clear safety requirements and emphasize safety first according to CapitaLand's enterprise regulations, and establish important position of safety on site. Site supervision is conducted by a Singapore consultant who employs many local staff. The safety level is graded by the owner regularly, and we could complete 90% of the whole safety requirements while the minimum proportion is 80% as stipulated in the contract.

We employ local workers as many as possible and Chinese workers account for only 2% in our project. They only do one type of installation work, because local workers' job could not meet the specification. The Chinese workers would go back home after they complete this work. We both employ local workers directly and use labor subcontractors. The directly employed workers mainly engage in core works, e.g. structure and fine fitment, while other works are awarded to local subcontractors.

2. What are the main safety and health problems in Chinese international contractors' overseas projects?

There were 3 incidents of materials falling from roof, and fortunately, they did not cause any struck-by accidents. There were also electrocution accidents. As some Chinese workers did not understand or respect local customs, there are fighting events between Chinese workers and local workers. In previous projects, there were also incidents of materials falling from tower crane and hoist dropping.

The backward social and economic level in Vietnam makes poor safety awareness of local workers. They disobey the safety regulations which add safety hazards on site. We have made many efforts on protection; however, there are always local workers injured due to going to unprotected areas. In addition, many local workers just wear their slippers on site due to local climate and lifestyle. Although we require mandatory wearing personal protective equipment, some of the local workers fail to obey.

3. What are the measures of safety management in Chinese international contractors' overseas projects? Any difficulties to implement these measures?

First of all, establish an integrated safety management system. The standards and laws should be used to regulate workers' behavior rather than rule of man. Violations should be taken photos as evidence. Second, establish specific safety schemes for different work trades. Thirdly, strengthening safety training and education, especially implementing daily toolbox meeting and sharing safety knowledge after work, could effectively improve project safety management level continuously. Fourthly, implement powerful safety inspection and supervision, and carry out safety production responsibility system. Fifthly, the senior management should give high position to safety management personnel in the project, and safety director of the company level should be set up above the project level. As productivity and progress sometimes take precedence over safety while we are shouting slogans of safety first, the management commitment to safety should be strengthened. Sixthly, mandatory regulations such as wearing PPEs and induction safety training should be enforced continually, although some workers grumble them due to local habits. Seventhly, use safety notices with multi-languages including Chinese, English and Vietnamese. Eighthly, implement safety award and safety penalty. For example, we fined around USD 80,000 to 100,000 for one of my previous projects. We also set particular budget for safety award. However, until the project was nearly finished, over 40% of the budget amount was not used. I do think this could reflect some safety status quo. We hold safety meetings with the participation of project manager, safety manager, safety officers and safety personnel of the subcontractors weekly. At the beginning, subcontractors thought these kinds of meetings were rather mechanical tyrannies as no accidents had happened. Our safety director of the company, the project safety manager and safety officers are all Chinese staff. The safety personnel of the subcontractors are normally educated local who could understand and accept the safety requirements easily, and our staff communicates with them in English. Then they distribute the safety information to their workers.

Of course there are difficulties. The first one is language barrier. Although the safety personnel of the subcontractors are generally well educated, most workers cannot understand English. In some occasions, we have to communication with the frontline workers directly. To overcome the language barrier, many of our Chinese staff has learnt basic Vietnamese. The second difficulty is weak safety awareness of local workers. I think this is related to backward local social economic development. Local subcontractors do not value life enough. A fatal accident compensation amount is only equivalent to one year's wages in Vietnam. Actually, in China, the fatal accident compensation standard is twenty times of city's annual wage. Third, local safety laws are quite inadequate. The governmental sectors never come to site unless they have received complaints. Actually, I think local government could be more powerful than contractors to enhance workers' safety

4. Would you please give some recommendations for improving safety management in Chinese international contractors' overseas projects?

First, Chinese contractors should be conscientious and care for construction safety of local workers, although safety is not taken seriously in some of the host countries. Second, understand the purpose of the safety subversion is to improve rather than to punish. Third, boost safety training and enforce mandatory safety regulations.

We provide directly employed local workers quite good accommodation conditions. Labor subcontractors provide accommodation to the workers on their own. Chinese workers live with us Chinese staff. I do not think Chinese workers would feel boring or suffer mental fatigue in Vietnam, as the surroundings are quite similar to China.

5. What are the factors affecting safety management level among international projects?

The first affecting factor is local climate. As weather in Vietnam is quite hot, we have to lower the standard. For example, sport shoes are also acceptable on site. The second affecting factor is local customs and culture. For example, lives are not cherished enough in Vietnam. Third, the development degree of the construction industry could restrict the safety management level. We think Vietnamese construction industry is 15 years behind China. Backward technology might increase safety hazards. Of course, the most important factor is the weak safety awareness of local workers.

6. What are the percentage of Chinese workers, local workers and workers from third countries in the frontline workers? What construction trades do they join each?

There are 2% Chinese workers and 98% Vietnamese workers in my current project. Chinese workers only do one type of installation work, because local workers' job could not meet the specification. All rest works are done by local workers. Actually, our company has gained great achievement in localization as we have entered into Vietnam market for 22 years. Other Chinese contractors may depend more on Chinese workers. In my opinion, high degree of human resource localization is necessary for Chinese international contractors.

7. Do you think nationalities, religions and employment ways could affect workers' safety performance?

I think there are certain influences. Different nationalities will definitely affect workers' safety performance and Chinese workers perform better on construction safety than their Vietnamese peers.

Religious people tend to be more careful than non-religious ones.

Directly employed workers perform better as they have received safety training continuously after the enrollment, and workers from labor subcontractors are normally temporary with insufficient safety training.

8. Other remarks:

It is really important to boost safety training of local workers.

Research Interview Report H

Interviewees: Interviewee H

Date: 12th June 2014

Time: 9:30 pm to 10:30 pm

1. Please introduce your project(s) generally, e.g. project type, contract type, contract value, duration, contract conditions (safety budget in the BOQ, contract terms regarding safety, e.g. safety procedures, health and safety for staff and labor), safety management system.

It is a harbor Engineering-Procure-Construct project that includes several terminals and matching facilities in Hanbantota, Sri Lanka. The owner is Sri Lanka Ports Authority and the project is partly aided by China. The contract conditions are FIDIC and the contract value is USD 808 million. It started in Nov. 2012 and will be completed in Nov. 2015. Safety budget is approx. 1% of the total contract value and there are basic safety clauses in the General Conditions of Contract. The HSE management systems are OHSAS 18001: 2007 and ISO 14001: 2004. When implementing any safety plans, we shall comply with the local laws and get approval from local authorities. The subcontractors are mainly local companies and Chinese companies. We supply accommodation to Chinese workers. However, we do not supply accommodation to local workers and they just go back home after work.

2. What are the main safety and health problems in Chinese international contractors' overseas projects?

The safety and health problems in this project are mainly: i) cofferdam structure instability that leads to collapsing, ii) improper management for explosion works, iii) traffic accidents and iv) heavy flying dust problem.

Due to the climate in Sri Lanka, workers have to work in the heat and may be affected by tropical diseases such as dengue fever. In addition, the local workers have cultural differences with Chinese, which sometimes could affect construction safety. For example, in Sri Lanka, many people do not wear shoes, so it is rather difficult to ask them to wear safety shoes on site. As the local workers never worked in the construction industry, their safety awareness is very low. Actually, they even do not know where is dangerous at the beginning. By contrast, language is not a problem. The Chinese foremen and engineers have learned basic local languages. Although the local workers use two different mother tongues, they can understand basic languages in the other one.

We do not have fatal accidents in this project. For the injured accidents of local workers, local law and local union will also play a role in protecting the workers.

3. What are the measures of safety management in Chinese international contractors' overseas projects? Any difficulties to implement these measures?

Safety management measures in our project include: i) establishing good safety management mechanism, ii) conducting safety education and training, iii) providing pre-construction safety disclosure; iv) conducting toolbox talk, v) using safety notices and signage in English, Chinese and two local languages, vi) emphasizing personal protective equipment and vii) building up effective contingency plans and carrying out safety drill.

The difficulties to implement these measures are low safety awareness of local workers, inadequate safety input and cultural differences between local people and Chinese management staff.

4. Would you please give some recommendations for improving safety management in Chinese international contractors' overseas projects?

To establish sophisticated safety management system, to increase safety input, to conduct more safety education and training and to implement effective supervision.

5. What are the factors affecting safety management level among international projects?

The low safety awareness of local workers and low safety management level of local subcontractors can affect safety management in international projects. Due to poor local production resources, it is hard to purchase safety protection materials, and we usually import them from China. Sometimes the materials could be delayed and impede safety management. The safety standard and force of supervision can also affect safety management level as we follow different safety standards in international and domestic projects, and the supervision enforcements from the employers and engineers are quite different in international and domestic projects. Sometimes non-project factors, mainly political factors could affect safety management. For example, instable political situations may bring about labor strike.

6. What are the percentage of Chinese workers, local workers and workers from third countries in the frontline workers? What construction trades do they join each?

The ratio of Chinese workers to local workers is 1 to 6 and there are no workers from third countries among the frontline workers. The Chinese workers are mainly foremen who can lead work or join construction trades that have high technical requirements such as caisson and explosion. The local workers plant operators, welders, electricians, lifting workers, foreman and other frontline workers. There are also local office staffs such as engineers and secretaries.

7. Do you think nationalities, religions and employment ways could affect workers' safety performance?

Yes, they could. Different nationalities may cause great cultural differences, language communication barriers and different safety concepts among frontline workers on site, which would affect workers' safety performance.

As the local workers are from two different religions, religious differences may cause conflicts between them. However, the effect of religious differences to the safety performance is not obvious, because workers from both religions have similar education levels.

Recruitment methods could affect the safety performance. Although we do not employ local labors directly, we can take one of our Chinese subcontractors as an example. This company rather hires workers directly or signs contract with labor subcontractors. Generally speaking, the directly hired workers' safety performance is worse, as workers from local labor subcontractors usually have more related working experiences and know more about local safety regulations.

8. Other remarks:

No.

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