IMPROVING THE SAFETY COMMUNICATION OF ETHNIC MINORITY WORKERS IN THE CONSTRUCTION INDUSTRY

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Improving the Safety Communication of Ethnic Minority Workers in the Construction Industry

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Certificate of Originality

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Keywords

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Abstract

The increasing employment of ethnic minority workers (EMWs) or migrant workers has formed a distinctive feature of the construction industry in many countries, such as European countries, the United States (U.S.), Australia, Middle Eastern countries, and Singapore. However, evidence shows that ethnic minority (EM) construction workers are more vulnerable to safety-related accidents and injuries than their local counterparts. Safety communication plays an important role in improving the safety climate and avoiding accidents at construction sites. Previous research has highlighted communication barriers as one of the major safety problems faced by EM construction workers. Thus, the safety communication of EMs deserves more attention.

This study aims to improve the safety communication of EMWs in the construction industry. Its objectives are to identify and evaluate the safety and health problems of EMs; identify the critical safety communication factors for EMs; explore the relationship between the safety communication factors and safety performance of EMs; compare the safety communication factors among EMs, management, and local workers; build the predominant safety communication structures of EMs; evaluate the safety communication structures of EMs; and investigate the relationships between the safety communication structures and safety performance of EMs.

To achieve these objectives, both qualitative (i.e., semi-structured interview) and quantitative methods (i.e., Delphi survey and questionnaire surveys) were employed in this study. The semi-structured interviews with 18 management professionals were initially conducted to determine the categories of safety and health problems and the safety communication factors of EMWs. Two rounds of a Delphi survey were employed to rank the relative severity of the identified safety and health problems. Questionnaire survey 1 was carried out with EM and local construction workers, and management staff in the Hong Kong and Australian construction industries to evaluate the safety communication factors and examine their relationships with safety performance. A total of 134, 202, and 95 valid questionnaires were collected from EMs, local workers, and management staff, respectively, in survey 1 and the overall valid response rate was 66%. Questionnaire survey 2 was conducted face-to-face with EM construction crews on sites in Hong Kong to build the safety communication

structures and examine their relationships with the safety performance of EMs. Responses were gathered from six EM crews, with the size of the crews ranging from 10 to 21.

The current study identified four categories and 14 subcategories of construction safety and health problems of EMWs. Among the 14 subcategories, the most urgent and serious were insufficient safety materials and training in their native language, insufficient safety staff from the EM's origin, and safety communication barriers. In addition, safety and health problems at the corporate and governmental levels are also worthy of attention. A total of 18 critical safety communication (SC) factors for EMs were identified from the perspective of EM construction workers and were categorised into three groups using exploratory factor analysis: (1) worker-related safety communication factors of EMs (WFEM); (2) management staff-related safety communication factors of EMs (MFEM); and (3) organisation-related safety communication factors of EMs (OFEM). The direct and indirect effects of critical SC factors on the safety performance of EMs were further examined using structural equation modelling.

The results showed that WFEM and MFEM had significantly positive direct effects on the safety compliance and safety participation of EMs. WFEM and MFEM also had significantly positive indirect effects on safety compliance and participation of EMs via safety knowledge and safety motivation. Safety knowledge and safety motivation were two complete mediators. The direct effect of OFEM on safety compliance and safety participation of EMs was not significant. OFEM only had indirect effects on the safety compliance and safety participation of EMs. The results of the comparative analysis of SC factors of EMs between management and EMs showed that 22 out of 36 SC factors were perceived as significantly different by EMs and management staff, all of which were perceived as more important by EMs than by management staff. There was significant disagreement regarding the rankings of SC factors between EMs and local workers. Twenty-eight out of 36 SC factors had a significant difference in the mean values as perceived by EMs and local construction workers, all of which were perceived as more important by EMs than by local workers. The predominant safety communication structures of EM construction crews were built and evaluated using social network analysis and their relationships with safety performance were examined. The results revealed that language proficiency, network density, and level of reciprocity were contributing factors that distinguished the high and low safety performing EM crews. EM management received more safety information from EM construction workers than local management. The centrality of EMWs was significantly related to their age, perceived priority of safety, and language ability.

This study sheds light on how to improve the safety communication of EM construction workers. It contributes by updating the existing body of knowledge on safety and health problems encountered by EM construction workers, the safety communication factors for EMs, and the safety communication networks of EM crews. Findings about key safety and health problems of EMs will be of value to various stakeholders in formulating safety and health measures for EM construction workers. The identified critical SC factors for EMs could help industry practitioners to diagnose deficiencies in safety communication management with EM construction workers. The relationship between SC factors and safety performance should be useful for safety professionals to improve the safety performance of EMs. The findings related to the safety communication networks of EM crews contribute to developing effective communication network patterns for EM construction workers.

List of Publications

Journal Papers

Lyu, S.*, Hon, C.K.H., Chan, A.P.C., Wong, F.K.W., Javed, A.A., 2018. Relationships among safety climate, safety behavior, and safety outcomes for ethnic minority construction workers. *International journal of environmental research and public health*, 15, 484.

Gao, R., Chan, A.P.C., Lyu, S., Zahoor, H., Utama, W.P., 2018. Investigating the difficulties of implementing safety practices in international construction projects. *Safety science*, 108, 39-47.

Chan, A.P.C., Wong, F.K.W., Hon, C.K.H., Lyu, S.*, Javed, A.A., 2017. Investigating ethnic minorities' perceptions of safety climate in the construction industry. *Journal of Safety Research*, 63, 9-19.

Chan, A.P.C., Wong, F.K.W., Hon, C.K.H., Javed, A.A., Lyu, S.*, 2017. Construction safety and health problems of ethnic minority workers in Hong Kong. *Engineering, construction and architectural management*, 24, 901-919.

Chan, A.P.C., Javed, A.A., Wong, F.K.W., Hon, C.K.H., Lyu, S., 2017. Evaluating the safety climate of ethnic minority construction workers in Hong Kong. *Journal of Professional Issues in Engineering Education and Practice*, 143, 04017006.

Chan, A.P.C., Javed, A.A., Lyu, S., Hon, C.K.H., Wong, F.K.W., 2016. Strategies for Improving Safety and health of Ethnic Minority Construction Workers. *Journal of construction engineering and management*, 05016007.

Conference Papers

Lyu, S.*, Chan, A.P.C., Hon, C.K.H., 2017. Investigating Safety Communication of Migrant Workers in the Construction Industry. *Chinese Research Institute of Construction Management* (*CRIOCM) 22nd International Conference on Advancement of Construction Management and Real Estate,* 2017, Swinburne University of Technology, Hawthorn, Melbourne, Australia.

Chan, A.P.C., Javed, A. A., Wong, F.K.W., Hon, C.K.H, Zahoor, H., Lyu, S., 2014. The application of social network analysis in the construction industry of Hong Kong. *Abstract Book of 1st International Conference on Emerging Trends in Engineering, Management & Sciences,* p. 31, 2014. City University of Science & Information Technology (CUSIT).

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List of Abbreviations

Abbreviation	Term
AVE	Average variance extracted
COMP	Safety compliance
CFI	Comparative fit index
CR	Construct reliability
C.R.	Critical ratios
DSP	Determinant of safety behaviours
EFA	Exploratory factor analysis
EM	Ethnic minority
EMWs	Ethnic minority workers
EMs	Ethnic minorities
GFI	Goodness-of-fit index
IEA	Importance-explanation analysis
IFI	Incremental fit index
KMO	Kaiser–Meyer–Olkin
KNOWL	Safety knowledge
MFEM	Management staff-related SC factors of EMs
MFL	Management staff-related SC factors of local workers
MOTIV	Safety motivation
NNFI	Non-normed fit index
OFEM	Organization-related SC factors of EMs
OFL	Organization-related SC factors of local workers
PART	Safety participation
PCA	Principal component analysis
PCFI	Parsimony comparative fit index
PGFI	Parsimony goodness of fit index
PPE	Personal protective equipment
PNFI	Parsimony normed-fit index
RMSEA	Root mean square error of approximation
SC	Safety communication
SCI	Safety climate index
SD	Std. Deviation
S.E.	Standardized error
SEM	Structural equation modelling
SP	Safety performance
SPSS	Statistical package for the social sciences
TLI	Tucker-Lewis index
U.K.	United Kingdom
U.S.	United States
WFEM	Workers-related SC factors of EMs
WFL	Worker-related SC factors of local workers
χ^2/df	Chi-square/degrees of freedom
β	Standardized factor loading
R^2	Squared multiple correlations

Chapter 1: Introduction

1.1 INTRODUCTION

This chapter outlines the background for this research, describes the problem statement, states the research aim and objectives, discusses the project's significance and value, and provides the structure of the thesis.

1.2 BACKGROUND

1.2.1 Ethnic minorities (EMs) in the construction industry

Ethnic minority (EM) in this study refers to a group within a community which has different national or cultural traditions from the main population. The increasing employment of ethnic minority workers (EMWs) or migrant workers has formed a distinctive feature of the construction industry in many countries, such as European countries, the United States (U.S.), Australia, Middle Eastern countries, and Singapore. For instance, EMWs in Europe accounted for nearly 10% of the total construction workers in 2007 (Lillie and Greer, 2007). EM construction workers comprised approximately 12.6% and 50% of the construction workforce in the United Kingdom (U.K.) and London in 2015, respectively, and approximately one out of every four employers recruited EM construction workers (Construction Industry Training Board, 2017). The proportion of EMWs in the construction workforce in Spain reached 30% (Meardi et al., 2012). In the U.S., Hispanics and Latinos constituted 16.1% of overall employed people in 2014. Among major industries, the construction industry has the largest share of Hispanic or Latino workers in the U.S (Bureau of Labour Statistics, 2015). The number of Hispanics or Latino workers in construction has been continuously growing. The proportion of Hispanic workers in the total construction workers in the U.S. has dramatically increased from 10.4% in 1995 to 29.8% in 2017 (Bureau of Labour Statistics, 1995; 2017). Malaysia began to depend on EMWs from the 1980s, and approximately 69% of construction workers in recent years have been EMWs (Abdul-Rahman et al., 2012). The Australian construction sector is also characterised by a multicultural and multi-ethnic workforce. The EMWs in Australia account for approximately 20% of the total construction workforce (Department of

Immigration and Citizenship, 2009), and this figure is anticipated to continue to grow (Loosemore et al., 2011).

The Hong Kong construction industry has also increasingly recruited EMWs. Hong Kong construction industry is in its busiest stages over the past 20 years, resulting in a remarkable demand growth for construction workers (Legislative Council, 2012). Due to a serious ageing problem in the Hong Kong construction sector (Legislative Council, 2012), the Hong Kong government has formulated some strategies to attract and employ EMWs. According to the 2016 Population Census Thematic Report on Ethnic Minorities, there were 584,383 EMs in 2016 in Hong Kong, which increased significantly by 70.8%, from 342 198 in 2006, accounting for 8.0% of the whole population in 2016 (Census and Statistics Department, 2016, p. 7). Of all male EMs, 11.3% were employed in the construction sector (Census and Statistics Department, 2016, p. 90). Statistics reveal that Nepalese (23.2%) and Pakistanis (18.9%) made up the largest proportion of male EMs (Census and Statistics Department, 2013, p. 78).

1.2.2 Safety performance of EM construction workers

Although many improvements in occupational safety and health have been achieved through great efforts by researchers, practitioners, and governments, the construction industry is still one of the most accident-prone sectors in many countries, with negative impacts on workers, employers, and the public (Kines et al., 2010; Sousa et al., 2014). For instance, the construction industry employed approximately 6.7% of the total workforce in the U.S. in 2015 (Bureau of Labour Statistics, 2016a); however, it was responsible for 19.4% of fatal work injuries among all sectors in the same year (Bureau of Labour Statistics, 2016b). In Singapore, 41% of fatalities in 2015 and 36% in 2016 occurred in the construction industry, which was the major cause of workplace fatalities (Ministry of Manpower Singapore, 2017).

Among all construction workers, EM construction workers have been found to be more vulnerable to accidents, as revealed by extensive studies (Loosemore and Lee, 2002; Dong and Platner, 2004; Goodrum and Dai, 2005; Trajkovski and Loosemore, 2006; Dong et al., 2010; Roelofs et al., 2011; Tutt et al., 2011; Cigularov et al., 2013). For instance, Goodrum and Dai (2005) analysed the differences in injuries, illnesses, and fatalities between Hispanic and non-Hispanic construction workers in the U.S. across five occupations: carpenters, construction labourers, painters, drywall installers, and electricians. Their results showed that Hispanic and non-Hispanic construction workers exhibited a disparity in injuries and illnesses. Dong et al (2010) analysed work-related injuries among Hispanics in the U.S. construction sector and revealed that Hispanics were more subjected to injury prone conditions than their white and non-Hispanic counterparts. They were also likely to be exposed to higher level of risks.

In addition, there is strong statistical evidence demonstrating that EMWs experience a disproportioned number of fatal and injury accidents in comparison with their level of employment (Loosemore and Lee, 2002; Dong and Platner, 2004; Goodrum and Dai, 2005; Trajkovski and Loosemore, 2006; Dong et al., 2010; Roelofs et al., 2011; Tutt et al., 2011; Cigularov et al., 2013). For example, Hispanic workers made up 25.5% and 27.3% of the total construction workforce in the U.S. in 2012 and 2013, but contributed to 27.4% and 29.1%, respectively, of the total fatalities (Hallowell and Yugar-Arias, 2016). According to the report by the Centre for Construction Research and Training (2013), Hispanic construction employees had a 48% higher average fatality rate compared to their local counterparts. EMWs in the U.K. accounted for 17% of construction deaths during 2007-2008, while the estimated number of EMWs ranged from 2.4% to 8% of the construction workforce (Centre for Corporate Accountability, 2009). It is reasonable to believe that EMWs in the Hong Kong construction sector face a similar challenge. However, the construction safety risks for EMs in Hong Kong have long been overlooked and not made evident because there is no official and separate safety record for EMs. To date, no such statistics are available in Hong Kong. A comprehensive search in Wise News, a local newspaper archival database, was conducted to calculate the construction fatalities of EMWs. The search revealed that there were 69 EM accidents between 1998 and June 2014 (see Appendix A), including 49 non-fatal accidents and 20 fatal accidents. The number of EMs injured and killed was 84 and 23, respectively. As shown in Table 1.1, fall of person from height (N = 23, P = 33%), struck by falling object (N = 12, P = 17%), trapped by collapsing or overturning object (N = 6, P = 9%), exposure to explosion (N = 6, P = 9%) were the major causes of EM accidents.

Table 1.2 shows the distribution of the ethnicity of EMs involved in construction accidents in Hong Kong between 1998 and June 2014. Although the nationality of some workers was unclear, it was found that Nepalese and Pakistani workers made up a relatively large proportion of the EMs involved in accidents. The accident statistics obtained from this method may be underestimated, as it is possible that some fatal accidents of EMs were not reported in the newspapers. Thus, the actual number of fatal accidents is deemed to be much larger.

Table 1.1 Types of EM accidents in the construction industry of Hong Kong between 1998 and June 2014 (Source: Wise News)

Types of EM accidents	All accidents		Fatal accidents		Non-fatal accidents	
	N	*P*	*N*	*P*	*N*	*P*
Fall of person from height	23	33%	11	55%	12	24%
Struck by falling object	12	17%	1	5%	11	22%
Trapped by collapsing or overturning object	6	9%	3	15%	3	6%
Exposure to explosion	6	9%	0	0%	6	12%
Slip, trip or fall on same level	5	7%	0	0%	5	10%
Striking against or struck by moving object	5	7%	1	5%	3	6%
Others	3	4%	2	10%	1	2%
Exposure to or contact with harmful substance	2	3%	0	0%	2	4%
Contact with electricity or electric discharge	2	3%	1	5%	1	2%
Struck by moving vehicle	1	1%	1	5%	0	0%
Contact with moving machinery or object being machine	1	1%	0	0%	1	2%
Exposure to fire	1	1%	0	0%	1	2%
Injured by hand tool	1	1%	0	0%	1	2%
Injured in workplace violence	1	1%	0	0%	1	2%
Trapped in or between objects	1	1%	0	0%	1	2%

Note. Data consolidated from cases in Wise News database; *P* = Percentage.

Table 1.2 Ethnicity of EMs involved in construction accidents of Hong Kong between 1998 and June 2014 (Source: Wise News)

Ethnicity	Number	Percentage
Nepalese	54	50%
EM	19	18%
South Asian	13	12%
Pakistani	8	7%
German	2	2%
Indian	1	1%
Nigerian	1	1%
Philippine	3	3%
Thai	1	1%
Vietnamese	5	5%

Note. Data consolidated from cases in Wise News database; EM refers to the EMWs whose ethnicity was not disclosed in the newspapers.

As shown in Table 1.3, the fatalities of EMWs accounted for nearly 5.4% ($N = 23$) of all construction fatalities ($N = 423$) from 1998 to June 2014, whereas EM construction workers represented 1.5% of the Hong Kong construction workforce in 2011 (Hong Kong Labour Department, 2014), which indicates that EM construction workers in Hong Kong are also suffering a disproportioned fatal rate compared with their level of employment. Considering the above statistics and the fact that EMWs make up a significant part of construction workforce in many countries (e.g., Hispanic workers in the U.S., Polish workers in Europe, Chinese and Thai workers in Korea, Chinese, Indian, and Filipino workers in Singapore and the Middle East), special attention should be directed to the safety and health of EMWs.

Table 1.3 Number of industrial fatalities for local workers and EMWs in the Hong Kong construction industry

Accident/Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
No. of accidents	19588	14078	11925	9206	6239	4367	3833	3548	3400	3042	3033	2755	2884	3112	3160	3232	3467	100869
No. of local fatalities	55	45	28	22	24	24	17	25	15	19	20	17	8	21	24	19	17	400
No. of EM fatalities	1	2	1	6	0	1	0	0	1	0	0	2	1	2	0	3	3	23
Total fatalities	56	47	29	28	24	25	17	25	16	19	20	19	9	23	24	22	20	423
% of EM fatalities	1.81	4.25	3.45	21.43	–	4	–	–	6.25	–	–	10.53	11.11	8.70	–	13.64	15%	5.4
Overall accident rate/1000 workers	247.9	198.4	149.8	114.6	85.2	68.1	60.3	59.9	64.3	60.6	61.4	54.6	52.1	49.7	44.3	40.8	–	–
Overall fatalities rate/1000 workers	0.71	0.66	0.36	0.35	0.33	0.39	0.27	0.42	0.30	0.38	0.41	0.38	0.16	0.37	0.34	0.27	–	–

Note. Data consolidated from cases in Wise News database and Hong Kong Labour Department (2014)

1.3 PROBLEM STATEMENT

The safety of the EM group in construction has been a pressing global concern (Trajkovski and Loosemore, 2006; Bust et al, 2008). In developed countries, such as the U.K., Australia, and the U.S., an increasing number of EMWs are employed in the construction industry. The proportion of EMs in the construction workforce is expected to continue to increase. Statistics show that EMWs are more vulnerable to work-related injuries than their local counterparts in some developed and developing countries. As the proportion of EMWs in the construction industry continues to increase, attention should be paid to the safety and health of EMWs.

The safety and health problems experienced by EMWs have drawn much attention from previous researchers. However, most of these studies are out-dated (Ministry of Business, Innovation and Employment 2014) and only cover a few points on safety and health problems. A comprehensive investigation of the safety and health problems facing EM construction workers is essential to have a better understanding of this vulnerable group.

The safety communication barrier is considered one of the most severe safety problems for EMWs (Chan et al. 2017c). EMWs have difficulty with open and proactive communication with their local co-workers and safety supervisors, such as an inability to report a risky situation, reject unsafe tasks, express their worry, and fully comprehend the instructions or risks associated with some work (Guldenmund et al., 2013). Many EMWs have misunderstood safety instructions and made some mistakes (Trajkovski and Loosemore, 2006). Since many studies have revealed that effective safety communication could contribute to a decrease in occupational near-misses, injuries, or fatalities (Smith et al., 1978; Zohar, 1980; Bentley and Haslam, 2001) and the improvement of the safety climate (Kines et al., 2010; Liao et al., 2014a) and safety behaviours (Mattila et al., 1994; Zohar and Luria, 2003; Cigularov et al., 2010; Liao et al., 2014b), the safety communication of EMs deserves more research attention by the research community and society. In addition, safety communication networks can facilitate or restrain the flow of information, resources, or materials among crew members (Tröster et al., 2014). Alsamadani et al (2013a) revealed that effective safety communication patterns and structures would contribute to a better safety performance of multicultural construction crews. Thus, developing an effective safety communication network for EMWs is also of great importance to improve their safety. Moreover, higher jobsite communication density has been found to be associated with an improved safety climate, which would contribute to the improvement of safety performance (Liao et al., 2013; Liao et al., 2014a). However, Dainty et al. (2007b) revealed that the existing communication channels were usually ineffective for EMWs to convey their message and concerns. There is a lack of an effective dissemination system that provides assistance and support to EMWs, as well as advisory or feedback mechanisms in the construction industry regarding the employment problems of EMWs.

Many studies on communication have been conducted in the field of psychology, education, healthcare, and business management; however, research on the safety communication of EMWs in construction is rare, particularly at the site level (Simard and Marchand, 1994; Cigularov et al., 2010). Among the limited studies on communication in construction, only a few have explored the safety communication factors influencing safety performance, especially for EMWs who face various safety communication problems. Additionally, the majority of studies on communication networks in the context of the construction industry have focussed on organisational-level networks (Zheng et al., 2016). Although the focus has started to expand to involve small teams, very few efforts have been made thus far to explore the communication networks of EM crews in relation to safety information. Thus, the current study aims to fill the research gaps of safety communication factors and communication networks of EMs, which are two key aspects of communication.

1.4 RESEARCH AIM AND OBJECTIVES

The current study aims to improve the safety communication of EMWs in the construction industry. Seven specific objectives were determined to address the aforementioned research problems:

Objective 1. Identify and evaluate the safety and health problems of EMs.

Objective 2. Identify the critical safety communication factors of EMs.

Objective 3. Establish the relationships between safety communication factors and the safety performance of EMs.

Objective 4. Compare the safety communication factors among EMs, management staff, and local workers.

Objective 5. Build the predominant safety communication structures of EMs.

Objective 6. Evaluate the safety communication structures of EMs.

Objective 7. Investigate the relationship between safety communication structures and the safety performance of EMs.

The connections among the objectives are presented in Figure 1.1. This study began by identifying and evaluating the safety and health problems experienced by EMs (Objective 1) as the background investigation of EMs in the construction industry. After grasping a solid understanding of the safety and health problems of EM construction workers, two key aspects of safety communication were examined: safety communication factors (Objectives 2, 3, and 4) and safety communication networks (Objectives 5, 6, and 7).

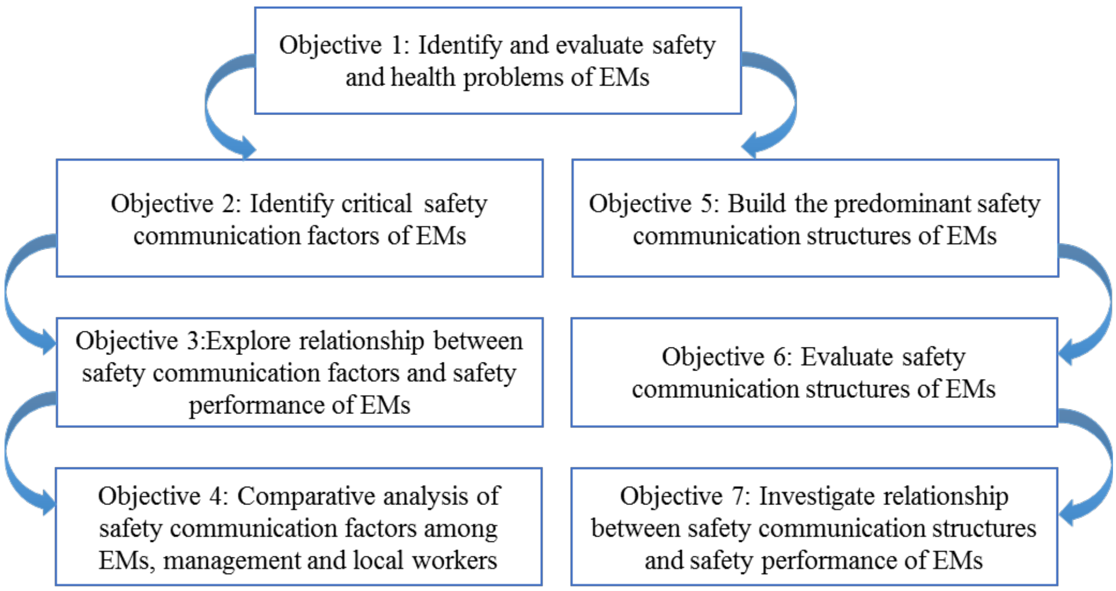

Figure 1.1 Connections among the seven objectives

As for the safety communication factors, critical safety communication factors of EMs were identified (Objective 2) and these factors were then adopted to explore the relationships between the critical safety communication factors and safety performance of EMs (Objective 3). Having explored EMs' perceptions of safety communication factors, a comparative analysis of safety communication among EMs, management staff, and local workers was then conducted (Objective 4).

To explore the safety communication networks of EMs, the predominant safety communication structures of EM crews were built (Objective 5). The safety communications structures derived from Objective 5 were then evaluated (Objective

6). The network level and individual level of measures from Objective 5 were employed to investigate the relationships between safety communication structures and safety performance of EMs (Objective 7).

1.5 RESEARCH APPROACH

The aim of this study is to improve the safety communication of EM construction workers who are more vulnerable than their local counterparts. The research framework to achieve the seven specific objectives is presented in Figure 1.2. A mixed-research method was adopted. The qualitative research approach applying semi-structured interviews, and the quantitative research approaches utilising a Delphi survey and questionnaire survey were carried out for data collection.

To achieve Objective 1, the studies on safety and health problems experienced by EM construction workers in both developing and developed countries were firstly reviewed to obtain a better understanding of the safety issues of EMWs. A total of 18 face-to-face semi-structured interviews were then carried out with professionals, from contractors, government organizations, quasi-government organizations, and client in Hong Kong. The interview transcripts were analysed based on constant comparisons with the help of qualitative analysis software QSR NVivo 10. The safety and health problems identified through the interviews were evaluated by an expert panel in two rounds of the Delphi survey. The expert panel consisted of project managers, site engineers, project directors, assistant project managers, contract managers, and service managers. All of the experts had rich work experience in construction and various work experience in managing EM construction workers.

To achieve Objective 2, a systematic literature review on communication theory and the factors influencing effective communication factors in construction and other settings and semi-structured interviews were conducted. To achieve Objective 3, literature on the measurement of safety performance was reviewed to design the statements to evaluate safety performance, and studies on the relationship between safety communication and safety performance were reviewed to develop the research models. The data collected from EM construction workers in questionnaire survey 1 were analysed using a mean scoring technique in Statistical Package for Social Science (SPSS) software to determine the critical safety communication factors of EMs (Objective 2). The identified critical safety communication factors were grouped using exploratory factor analysis. The relationships between safety communication factors and the safety performance of EMs were evaluated through structural equation modelling using IBM SPSS Amos (Analysis of Moment Structures) (Objective 3). The data collected from management staff and local construction workers in questionnaire survey 1 were analysed using Kendall's coefficient of concordance, Spearman rank-order correlation, and independent *t*-test for a comparative analysis of the safety communication factors among EMs, management staff, and local workers (Objective 4).

To achieve Objectives 4, 5, and 6, a three-section instrument was designed for questionnaire survey 2, in which the statements regarding safety climate adopted the 38 safety climate items of Hong Kong's Occupational Safety and health Council (OSHC 2008) and the questions related to the safety communication network were designed based on the study of Alsamadani et al. (2013a). The questionnaires for survey 2 were administered face-to-face with EM crews. The data about safety communication networks were input to NetDraw software to build the safety communication structures of EM crews (Objective 5). Both network level and actor level measures were computed using the social network analysis approach using UCINET software to evaluate the safety communication structures of EMs (Objective 6). The relationships between the safety communication structures and safety performance of EMs were evaluated using Mann-Whitney *U* test and Kruskal-Wallis test (Objective 7).

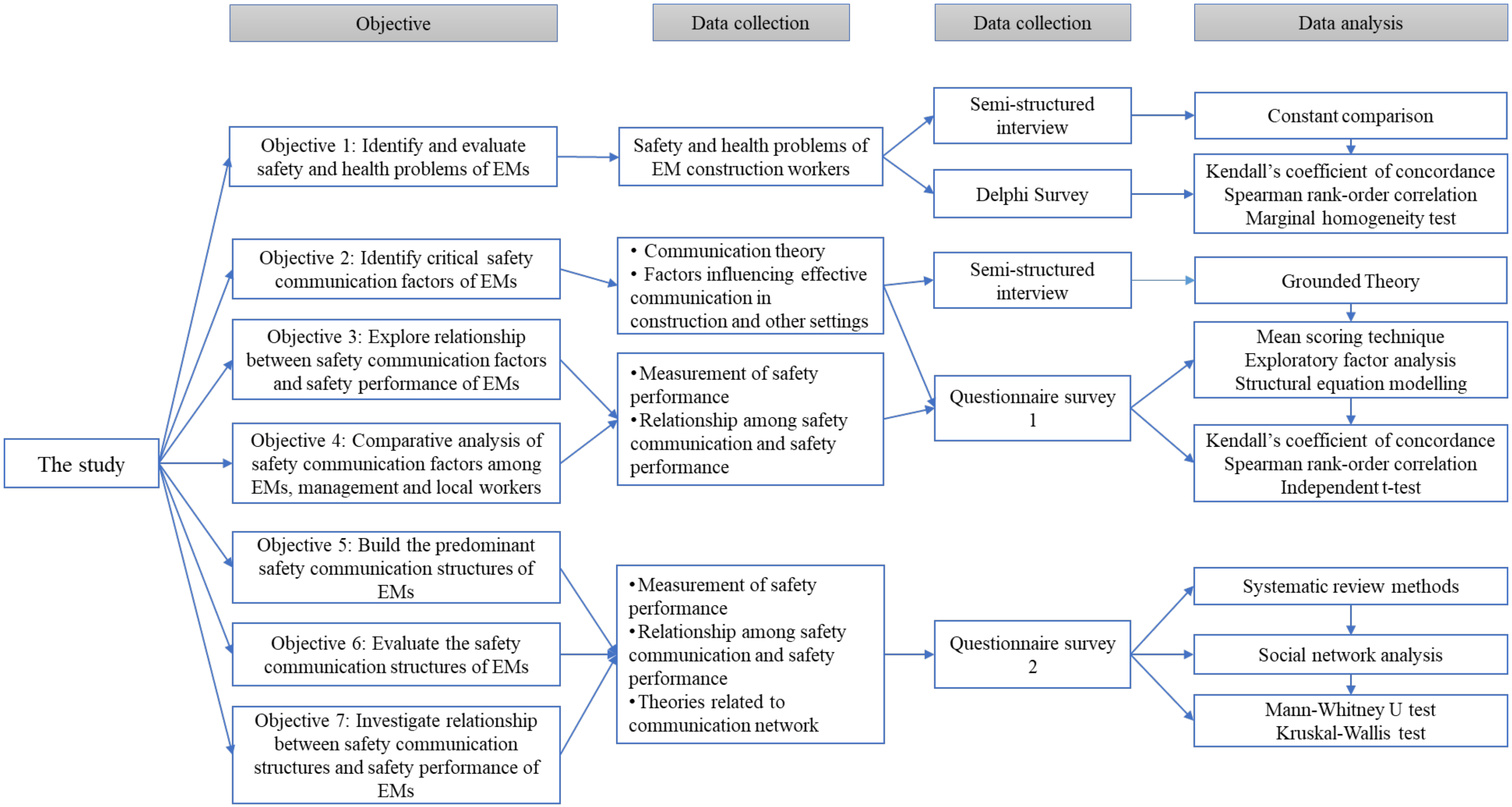

Figure 1.2 Research framework for the study

1.6 PROJECT SIGNIFICANCE

The number of EMWs in the construction industry is expected to increase further to mitigate the growing demand for a construction workforce. Problems pertaining to safety have emerged with the growing employment of EMWs (Chan et al. 2016). Previous studies and statistics have demonstrated that EMWs are more vulnerable to accidents and injuries than their local counterparts (Loosemore and Lee, 2002; Dong and Platner, 2004; Goodrum and Dai, 2005; Trajkovski and Loosemore, 2006; Dong et al., 2010; Roelofs et al., 2011; Tutt et al., 2011; Cigularov et al., 2013). As the proportion of EMWs in the construction industry continues to grow, the safety and health of this vulnerable group deserves more attention.

Although some studies have investigated the safety and health problem facing EMWs in construction, the majority have focussed only on very few of the related issues, such as Abdul-Aziz and Abdul-Rashid (2001), Loosemore and Chau (2002), Trajkovski and Loosemore (2006). This study firstly identifies and evaluates the relative severity of the safety and health related problems experienced by EMWs comprehensively and systematically. The significance lies in updating and enriching the limited body of knowledge on the safety and health problems of EMWs. The findings can assist safety professionals and government agencies to design effective measures for the improvement of their safety.

Studies on safety communication for EM construction workers are still limited. Safety communication is regarded as one of the key safety problems that would influence EMs safety performance (Alsamadani et al. 2013a, Chan et al. 2017). However, among the limited studies on safety communication of EMs, very few have analysed the factors that affect safety communication and the safety communication structures of EMs, which are two important aspects of safety communication. Thus, this study aims to fill the research gaps regarding the safety communication of EM construction workers by identifying the critical factors of safety communication for EMWs and effective safety communication structures. The identified safety communication factors will assist with diagnosing the existing deficiencies in safety communication management with EMWs. A better understanding of the mechanism by which safety communication factors influence the safety performance of EMWs can help the employers to design safety and prevention programs for EMWs. The investigation of the safety communication structure of EM crews and their effects on safety performance can help the management to construct well-structured networks for EM crews to deliver safety messages to EMWs more effectively and efficiently. The findings of the current research will contribute to removing the safety communication barriers of EMWs, which will in turn improve their safety performance.

1.7 THESIS STRUCTURE

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

Chapter 2 reviews the literature to provide a foundation for the research objectives, including the safety and health problems of EMWs, communication theory, communication factors, measures of safety performance, effects of safety knowledge and safety motivation on safety performance, effects of safety communication on safety climate and safety performance, theories related to communication networks, and strategies for safety communication improvement.

Chapter 3 introduces and explains the research methodology employed to achieve the seven objectives of this study. Both qualitative and quantitative research methods were considered and selected, including a literature review, semi-structured interviews, Delphi survey, and questionnaire surveys. The data analysis techniques adopted in this study, such as descriptive statistics, analysis of variance, factor analysis, structural equation modelling, and social network analysis are also presented.

Chapter 4 presents the findings from the face-to-face semi-structured interviews and two-round Delphi survey to fulfil Objective 1, which identifies and evaluates the relative severity of the safety and health related problems experienced by EMWs.

Chapter 5 presents the research findings of Objectives 2 and 3. The critical safety communication factors for EMs are identified. The relationships between critical safety communication factors and safety performance of EMs are established.

Chapter 6 presents the research findings of Objective 4. The critical safety communication factors of EMs perceived by management staff are identified. The ranking difference in safety communication factors of EMs between management and

EMs is analysed. In addition, critical safety communication factors for local workers are also identified. The ranking difference in safety communication factors between local workers and EMs is then discussed. The relationships between safety communication factors and the safety performance of local workers are also established.

Chapter 7 presents the research results of Objectives 5, 6, and 7. The predominant safety communication structures are built, the relationships between safety communication structures and the safety performance of EM crews are analysed, and the effects of workers' personal attributes on their position in the networks are evaluated.

Chapter 8 discusses the key research findings reported in Chapters 4, 5, 6, and 7. The research findings are interpreted and discussed with reference to theories and previous research, and recommendations for how to improve the safety communication and safety performance of EMWs are provided.

Chapter 9 provides a summary of the research findings and their implications. The significance, limitations, and recommendations for future research directions are also highlighted.

1.8 CHAPTER SUMMARY

This chapter outlined the framework to conduct this study, including: (1) introduction; (2) research background; (3) problem statement; (4) research aim and objectives; (5) project significance and value; and (6) thesis structure.

Chapter 2: Literature Review

2.1 INTRODUCTION

This chapter presents a review of the literature that established the basis of this research. As depicted in Figure 1.2, the literature on the following topics was reviewed:

- safety and health problems of EMs (Section 2.2);
- communication theory (Section 2.3);
- communication factors (Section 2.4);
- measurement of safety performance (Section 2.5);
- the relationship between safety knowledge, safety motivation, and safety performance (Section 2.6);
- the relationship between safety communication and safety performance (Section 2.7);
- theories regarding communication network (Section 2.8);
- strategies for safety communication improvement (Section 2.9).

To identify and evaluate the safety and health problems of EMs (Objective 1), studies on safety and health problems of EMs in different countries were reviewed. Having obtained a solid understanding of the safety issues of EMs, communication theories, including the definition of communication, theoretical models of communication, and key elements of the communication process were reviewed to serve as a foundation of this safety communication study. To achieve the objective of identifying the critical safety communication factors of EMs (Objective 2), studies on communication factors in the setting of construction, education, business, and health care were reviewed, including the factors influencing effective communication in construction, cross-cultural communication in construction, and effective communication in other settings. In addition, these studies on communication factors were summarised and consolidated. To achieve the objectives of investigating the relationship between safety communication factors and the safety performance of EMs, and comparing the safety communication factors among EMs, local workers, and management, literature regarding the measurement of safety performance; the relationships between safety knowledge, motivation, and safety performance; the relationship between safety communication and safety performance; and strategies for safety communication improvement were reviewed. To achieve Objectives 5, 6, and 7, which were also related to the safety communication network, the literature on communication theory, the relationship between safety communication and safety performance, and theories regarding safety communication networks were reviewed.

2.2 SAFETY AND HEALTH PROBLEMS OF EMS[1]

Some researchers have investigated the safety and health problems encountered by EM construction workers. Table 2.1 summarized the findings of literature review on safety and health problems of EM construction workers in different jurisdictions, such as Australia (Loosemore and Chau, 2002; Loosemore and Lee, 2002), Brunei (Santoso, 2009), Malaysia (Abdul-Aziz and Abdul-Rashid, 2001), Singapore (Loosemore and Lee, 2002), Spain (Ahonen et al., 2009), the U.S. (Roelofs et al., 2011), and the U.K. (Dainty et al., 2007b).

U, and. The major safety and health problems of EMWs include a lack of safety and health awareness, low skill levels, language and communication barriers, insufficient safety training and materials for EMWs, insufficient support from government and corporate sectors, cultural and religious differences, and racial discrimination.

Many EMWs seldom realise the long-term effects of their construction work (e.g., hang arm vibration syndrome) and are unaware of the importance of safety and health management. Their safety awareness is lower than that of their local counterparts (Dainty et al., 2007b). Moreover, they are always recognised as unskilled compared with local workers, which may be due to their insufficient work experience in the construction industry (Abdul-Aziz and Abdul-Rashid, 2001).

The language barrier is among the major obstacles to the integration of EMWs into the local work environment and is a serious issue that negatively influences the commitment and safety communication of construction workers (Loosemore and Lee,

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[1] Published in Chan, A.P.C., Wong, F.K.W., Hon, C.K.H., Javed, A.A., Lyu, S.*, 2017. Construction safety and health problems of ethnic minority workers in Hong Kong. *Engineering, Construction and Architectural Management*, 24, 901-919.

2002). It is also a cause of higher accident rates (Trajkovski and Loosemore, 2006). In Singapore, language and communication barriers of EMWs was considered the fifth most serious issue that hindered the development of the construction industry (Lim and Alum, 1995). In South Korea, misunderstandings in communication between EMWs and management is one of the contributory factors determined to lead to project failures (Han et al., 2008a). Interaction with local workers and staff immediately through verbal communication at construction sites is difficult for EMWs (Bust et al. 2008). Some EMWs have difficulty in comprehending specific instructions given by their foremen (Santoso, 2009). Cigularov et al. (2010) found that workers' safety communication with foremen was positively related to their safety behaviour. The effective social network of construction can help improve knowledge sharing, which is fundamental to a high-performance team (Chinowsky et al., 2009). Poor language ability places the EMWs and their local co-workers in jeopardy (Dainty et al., 2007b). This issue experienced by EMWs should be given additional attention by the construction industry (Alsamadani et al., 2013a; Alsamadani et al., 2013b; Flynn, 2015).

Some EMWs perceived that they were not provided with sufficient safety training (Wong and Lin, 2014). In addition, most of the safety training provided to EMWs was informal and they had to learn to do their job by observing their more experienced co-workers (Ahonen et al., 2009). Governments mainly provide safety training in the local language, which is difficult for EMWs to understand (Trajkovski and Loosemore, 2006). Although EMWs may behave unsafely due to their insufficient safety and health knowledge, they compensate with their own character strengths, such as obedience, diligence (Abdul-Aziz and Abdul-Rashid, 2001), and a positive attitude (Dainty et al., 2007b). Thus, they might comply even better than local co-workers if they could understand the relevant knowledge (Dainty et al., 2007b). Furthermore, a qualitative study related to EM construction operations in Spain revealed that safety measures taken on site were mostly perfunctory (Ahonen et al., 2009). Although EMWs expressed their desire to improve safety mechanisms and request personal protective equipment (PPE), they eventually needed to purchase these themselves (Ahonen et al., 2009; Roelofs et al., 2011).

Many EMWs in the U.S. and U.K. felt that they were carrying out jobs that local workers were reluctant to take and their work environment was hazardous (Dainty et al., 2007b; Roelofs et al., 2011). They perceived that highly laborious and dangerous tasks were assigned to them; yet, they were paid less than local workers and pushed to finish their work more quickly (Ahonen et al., 2009). In addition, the lack of opportunities for recruitment and career development for EMWs is regarded as a major problem that might lead to desperation and demotivation (Wong and Lin, 2014).

Finally, EMWs also experience racial discrimination. This problem could have an adverse effect on the safety of EMWs (Loosemore and Chau, 2002). Racial discrimination is considered a cause of psychological health issues (Alleyne, 2004), including negative moods (Fox and Stallworth, 2005) and emotional trauma (Alleyne, 2004). Some local workers are reluctant to accept their EM counterparts because they perceive that EMWs undercut local workers, which leads to incidents of bullying, harassment, or discrimination (Dainty et al., 2007b). Racial discrimination was also found in the Hong Kong construction sector, which manifested itself in subtle and indirect racial harassment (Wong and Lin, 2014).

Table 2.1 Safety and health problems identified by previous researchers

Categories	Wong and Lin (2014)	Roelofs et al. (2011)	Ahonen et al. (2009)	Santoso (2009)	Dainty et al. (2007b)	Trajkovski and Loosemore (2006)	Loosemore and Chau (2002)	Loosemore and Lee (2002)	Abdul-Aziz and Abdul-Rashid (2001)	Number of times mentioned by previous researchers
1. Lack of safety and health awareness					√					1
2. Low skill level			√		√				√	3
3. Language and communication barriers	√	√	√	√	√	√			√	7
4. Insufficient safety training in EM native languages	√	√	√		√	√		√		6
5. Insufficient safety materials in EM native languages						√		√		2
6. Insufficient corporate safety culture		√	√					√		3
7. Insufficient government support			√		√					2
8. Assignment of heavier and more hazardous work	√		√		√					3
9. Cultural and religious differences	√	√		√				√		4
10. Lack of opportunities for EMWs' recruitment and career development	√				√					2
11. Racial discrimination against EMWs	√			√			√	√		4
Number of problems identified from each publication	6	4	6	3	7	3	1	5	2	

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2.3 COMMUNICATION THEORY

2.3.1 Definition of communication and safety communication

Before defining the safety communication of EM construction workers, it was necessary to review the definitions of communication. Communication theory has been practiced for more than 2,500 years (Philipsen and Albrecht, 1997). Various definitions for communication exist due to differences among the perspectives of researchers. According to Osgood et al. (1957), communication is one system in which communication media and the communication channel could affect communication performance. Axley (1984) defined communication as a metaphorical 'pipeline' along which information is transferred from one person to another. Guffey and Loewy (2010, p.10) defined communication as "transmission of information and meaning from one individual or group to another". Samovar et al. (2014, p. 7) described communication as "the management of messages with the objective of creating meaning". In the context of construction, Fischer's (1989) definition of communication in construction is the continuous and interdisciplinary sharing of goals, knowledge, and information among all project participants. Dainty et al. (2007a, p. 5) viewed communication as "a professional practice where appropriate rules and tools can be applied in order to enhance the utility of the information communicated, as much as it can a social process of interaction between people". After reviewing different definitions of communication, the safety communication of construction workers in this study is defined as "the transmission and exchange of safety and health related information and messages between the safety management and construction workers, or among construction workers onsite".

2.3.2 Theoretical models of communication

Previous researchers and scholars have developed several theoretical models for communication to explain the communication process, such as Shannon and Weaver (1949), Feldberg (1975), Torrington et al. (1995), and Emmitt and Gorse (2009).

Shannon and Weaver (1949) developed a linear communication model based on mathematical theory. It has spurred researchers from various disciplines to scientifically analyse communication. Feldberg (1975) proposed a communication model that consisted of four stages of the communication process (see Figure 2.1). The first stage is the process of communication between two parties and includes elements such as the sender, receiver, message, medium, expectation, reaction, and result of the message. The second stage is to identify the causes of incongruence of the sender's expectation and receiver's reaction, physical and psychological noise, defence, external pressure, and personal factors. The third stage is to find the mechanisms to assess the effectiveness of communication. The fourth stage is the reaction communicated by the receiver.

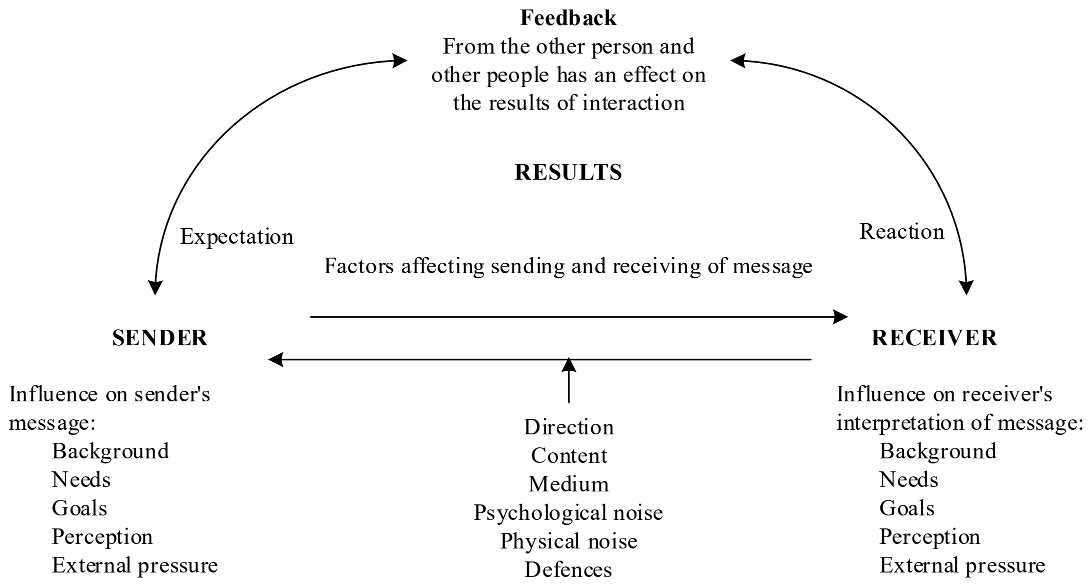

Figure 2.1 Model of communication.

Source: Adopted from Feldberg (1975).

In the context of construction, Dainty et al. (2007a) established a communication process model based on McHugh and Thomson (1990), as shown in Figure 2.2. In addition to the key elements of communication, such as the sender, receiver, noise and distortion, message, communication channels, communication media, and feedback, this model also takes external environmental factors in the construction industry into consideration. Dainty et al. (2007a) summarised the four common factors that could affect the effectiveness of communication, including:

- The effectiveness by which information is encoded and then transmitted through the communication system, channels, and networks.
- The appropriateness of the communication medium and channels used.

- How those receiving the communication decode, interpret, and act upon it.
- The abilities of those commentating to minimise ‘noise’ that could impede the process.

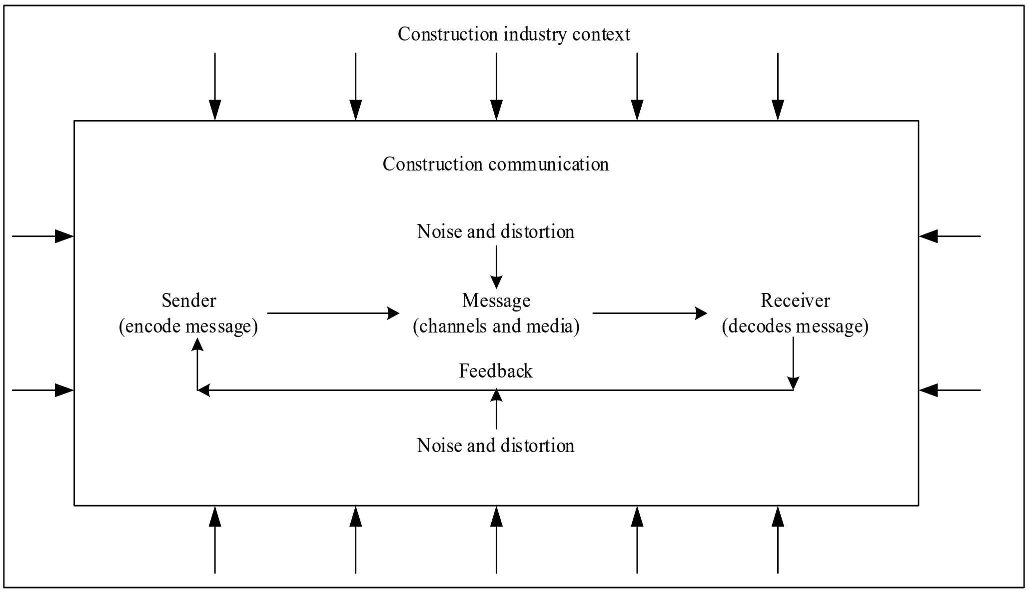

Figure 2.2 Construction industry context and communication process.

Source: Adopted from Dainty et al. (2007a).

Table 2.2 summarises the six reviewed communication models, which are increasingly complicated. The first model of communication, namely Shannon and Weaver (1949), was a linear model. It does not include an important component in the communication process-feedback, ignores the nature that communication is generally two-way, and the influence of context where communication occurs. The more modern models have added feedback, indicating that communication is a two-way process and interactive. The key components of the communication process identified from these communication models include: communicators, the message, communication media and channels, noise, and feedback, which are described in Section 2.3.3. The application of communication models helps to diagnose the factors that impair or facilitate communication and identify methods to improve communication performance.

Table 2.2 Communication models

Model	How communication works	Major elements	Directional flow
Shannon and Weaver (1949)	Transmitter sends information to the receiver who decodes the message, which could be distorted by noise.	Sender, receiver, noise, message	One-way
Thayer (1968)	Individuals generate and disseminate, acquire and process information in an on-going, dynamic process.	Receiver, originator, information processing and disseminating	Circular
Feldberg (1975)	Four stages as mentioned above.	Sender, feedback, receiver, results, factors affecting sending and receiving message, medium	Two-way
Baguley (1994)	Transmitter is continually sending and receiving feedback, including information similar to original message, through communication medium and channel.	Medium, channel, noise, feedback, transmitter, receiver	Two-way
Dainty et al. (2007a)	Communicators send and receive messages through a communication medium and channel, and provide feedback, which is distorted by noise and context.	Sender, receiver, noise and distortion, message, communication channels, communication media, feedback, and cultural context	Two-way
DeVito (2011)	Individuals send and receive messages that are distorted within a context, have some effect, and provide opportunities for feedback	Sender, receiver, distortion, feedback	Two-way

2.3.3Key elements of communication process

2.3.3.1 The sender and receiver

The sender is viewed as the person who relays the original information (message). The sender encodes the message into the most suitable communication medium in order to convey the message. The message selected for encoding and the medium used to transmit by the sender are possibly not suitable for the receiver to comprehend. The effectiveness of encoding a message is a major issue for construction communication. Some messages encoded in the context of multi-culture are difficult for others with different educational levels and languages to understand (Dainty et al., 2007a). It is necessary for the sender to take the receiver's background into account.

The receiver decodes the transmitted message according to the receiver's perception and understanding. Whether the message is fully received is dependent on the receiver's understanding of the sender's intention. However, this process is complicated, as the receiver could possibly misunderstand the sender's original meaning. Differences in education, nationality, religion, gender, ethnicity, language, and experience cause the understanding of the receiver to differ from the intention of the sender. Gibson and Hodgetts (1990) stated the understanding of message by the receiver can be influenced by factors including: (1) how much the receiver understands the topic, (2) the receptivity of the receiver, (3) the relationship and trust between the sender and receiver, and (4) the receiver's understanding and perception of the message.

2.3.3.2 The message

The message is defined as an idea encoded for transmission in an intended communication media by a selected communication channel. It can be divided into verbal and nonverbal (Baguley, 1994; Philipsen and Albrecht, 1997; DeVito, 2011).

2.3.3.3 Communication channel

Communication channels refer to the conduits through which the message is conveyed. The types of communication channel include a formal communication channel and an informal communication channel. Formal communication is the exchange of messages related to the official work of the organisation and could be classified into vertical (downward, upward) and horizontal (sideways) (Lunenburg, 2010b). A downward communication channel refers to information transmitted from a higher level to a lower level of the organisation. Canary and McPhee (2010) pointed out several objectives of a downward communication channel, including the implementation of goals, strategies, and objectives; job instructions and rationale; procedures and practices; performance feedback; and socialisation. However, the distribution of the message through a downward channel with a great distance from the top to the receiver may lead to its loss or distortion (Hargie and Tourish, 2009). An upward communication channel is regarded as a message conveyed from the lower level (e.g., workforce) to the higher level (e.g., management) of an organisation, such as the submission of progress reports and feedback. The formal safety communication channels in construction consist of formal presentations from upper management; written communication, such as safety signage, posters, e-mails, and memos; safety training and toolbox talks; and safety orientations (Jaselskis et al., 1996; Rajendran et al., 2009).

Informal communication channel refers to the exchange of unofficial messages that are unrelated to the organisation's formal activities. When formal communication channels are unable to convey the intended message, informal channels will be adopted (Sigband and Rossi, 1983). There is debate about which type of communication channel is more effective. Johnson et al.'s study (1994) revealed that an informal channel is more suitable to convey the overall mission for an organisation where a shared and common culture exists. Alsamadani et al. (2013a) investigated the relationship between safety communication channels and safety performance, and modelled safety communication into formal and informal modes. According to a cross-case comparison, they revealed that crews who undertook weekly formal and informal safety communication or formal safety training had higher safety performance.

2.3.3.4 Communication media

Different communication media have been perceived to have varying degrees of effectiveness. An appropriate method for transferring information supporting the communication process is of great importance to ensure that a message achieves its desired effect. In the context of construction, Pietroforte (1997) categorised communication media into rich and lean media. Rich and iterative media include meetings, face to face conversation, video conferencing, and drawing, which are characterised by synchronous communication and personalised messages, complex language, and a flexible format. They are suitable for use in ambiguous or ill-defined situations to reduce information uncertainty. Lean communication media include the post, faxes, bulletins, emails, the Internet and intranet, which are impersonal and asynchronous and dependent on rules, forms, procedures, or databases. Leaner communication media are required in the situations where information is less ambiguous and more certain.

Emmitt and Gorse (2009) conducted research to investigate the use of media in construction. Based on data collected through a postal questionnaire survey and interviews and observations of professionals' behaviour on site, they evaluated the effectiveness of communication media in construction. Their study revealed that the most effective communication media were face-to-face communication and letters and drawings. This was followed by faxes and drawings, verbal communication via telephone, faxes without drawings, and email with drawings. Email without drawings and letters without drawings were ranked as the least effective media. In addition, they also investigated the perceptions of construction professionals on the effectiveness of various communication environment. The four most effective communication environments were informal meetings with an action confirmed in writing, informal meetings, formal meetings with an action confirmed in writing, and formal meetings. Interestingly, these four types of communication media all involved meetings, which were considered to be more effective than telephone conversations, written communication, and through a coordinator. Communication through a third party was ranked as the least effective.

2.3.3.5 Noise

Noise is vital to communication, as it could hinder the receiver's understanding of information, even when the communication channels and media are suitable. Noise in construction not only includes the noisy environment of construction sites, which hinders people's verbal communication, but also the noise involved in the interfaces in the message chain, where the communicators could distort the message. The emotional impact of people is also a significant source of noise in construction. Communication is ineffective when communicators allow their emotions to influence their communication. Dickens (2002) investigated the types and frequencies of noise that can be found in communication in the construction industry. Their research found that professional bias was the most frequently occurring noise, followed by inappropriate channels, personal bias, intermediaries, imprecise language, jargon, and poor concentration.

2.3.3.6 Communication network

The communication network structure affects one's ability to process information (Emmitt and Gorse, 2009). Some basic types of communication network structures have been developed by psychologists, such as the wheel network, chain network, circle network, and comcon network. In the wheel network, all messages are sent from or to one person, which is highly centralised. In the chain network, the message flow is up and down and tends to be influenced by the gatekeeper. In the comcon communication model, all persons convey messages, which is highly decentralised. In centralised networks, communication mostly relies on a central person. This type of network is more appropriate to communicate simple work rather than complex work, because processing too much information makes the central person too saturated. In addition, the impact of a gatekeeper in the communication network is also important. The individual who decides on whether the message can be conveyed or not, filters message, reduces messages, or blocks the communication flow is the gatekeeper in the network (Emmitt, 1999). In the construction industry, safety information could be blocked, filtered, stored, and changed by gatekeepers due to different backgrounds of employees, such as work experience, educational level, and cultural background. When the gatekeeper exists in communication networks, it is essential to ensure that additional communication barriers are not caused by gatekeepers.

2.4 COMMUNICATION FACTORS

Although effective communication is vital to raise safety awareness, reduce accidents, decrease cost, and increase contractors' profitability, there is still a dearth of research regarding communication in the construction sector. Emmitt and Gorse (2009, p. 18) highlighted that "clearly, construction communication research is in its infancy and we must seek to learn from those social scientists and industrialists from other sectors, who have recognised the importance of communication for some time". Thus, literature related to communication factors in the construction industry was firstly reviewed. The studies on communication factors in other settings, such as business, education, and health care, which have been a step ahead in the terms of effective communication and cross-cultural communication, were also taken into consideration.

2.4.1 Factors influencing effective communication in construction

Research on communication in the context of construction has focused on the design and construction phase, such as Preece and Stocking (1999), Wong et al. (2004), and Ejohwomu et al. (2017), while a few studies have concentrated on the facility management phase, such as Choon Hua et al. (2005). The researchers of these studies are mainly from the U.K., Singapore, Hong Kong, Samoa, and Nigeria.

Preece and Stocking (1999) analysed the process of communicating safety information and found that there were eight major barriers to effective and efficient safety communication in construction contracting, including: (1) the absence of feedback, (2) frame of reference and selective listening, (3) sender credibility, (4) technical language and jargon, (5) filtering, (6) status differences, (7) time pressures, and (8) information overload.

Dickens (2002) identified and evaluated the factors that affected the receivers' understanding of messages in construction projects. These factors were ranked as: (1) accuracy of information and timeliness of information, (2) relevancy of information and insufficiency of information, (3) too much information (overload), (4) language used not clear, (5) the style or medium used, (6) the sender's power status, (7) destructive information, and (8) the recipients own background.

Wong et al. (2004) analysed the underlying factors influencing the safety communication between contractors and subcontractors in Hong Kong. Among 56 factors, they identified seven adverse factors and six positive factors through factor analysis approach. The results indicated that negative factors included: (1) developer's and main contractor's emphasis on time and cost, (2) poor morale and loyalty of workers, (3) working in poor environment, (4) site staff's lack of language ability, (5) overload of message and information, (6) high dispersal of sites and workforce mobility and organisation structure, (7) too much emphasis on face-to-face communication on an individual basis and written communication. The positive factors included: (1) accuracy and precision of information, (2) adequate provision of safety-related training, (3) fear of adverse consequence as a result of site accident, (4) emphasis on safety and authority of developer and main contractor, (5) safety provision and organisation culture, and (6) face-to-face communication.

Choon Hua et al. (2005) investigated communication among representatives of the building clients and their maintenance contractors in the field of facilities management in Singapore. According to their study: (1) checking information with users, (2) use of appropriate visualisation techniques, (3) sufficient manpower, (4) timing of information (5) client's feedback, (6) working experience, (7) client's attitudes, (8) straightforward work requests, and (9) contractor's suggestion matching the interests of clients were the positive factors achieving effective communication. The negative factors leading to ineffective communication included: (1) differences in personality and interest, (2) lack of checking of information with users and craftsmen, (3) use of inappropriate visualisation techniques, (4) insufficient resources, (5) timing of information, (6) working experience, (7) client's attitudes, (8) site constraints, (9) cultural barriers, and (10) organisational cultural barriers.

Based on a questionnaire survey with construction firms, Ejohwomu et al. (2017) identified and ranked 15 factors influencing communication in the Nigerian construction industry. They suggested that the top ten crucial factors influencing effectiveness of communication in construction projects included: (1) unclear objectives, (2) ineffective reporting system, (3) poor leadership, (4) lack of necessary skills, (5) unclear channels of communication, (6) limited resources, (7) poor listeners, (8) language difficulties, (9) information filtering, and (10) lack of trust. These factors were grouped into two categories: (1) managerial and technical barriers, and (2) credibility and background through factor analysis, with the former having a higher factor score.

2.4.2 Factors influencing cross-cultural communication in construction

Cross-cultural communication occurs frequently in a large amount of international construction projects or on construction sites where EMWs are employed. Communication in this context is complicated by differences in the languages and cultures involved (Tone et al., 2009). Based on a questionnaire survey and interviews with practitioners and key stakeholders in Samoa, Tone et al. (2009) revealed that cross-cultural communication tended to have more negative effects on the management of international construction projects instead of positive effects. They further identified 26 barriers to effective communication, with the top ten barriers including: (1) poor work ethic, culture, and practices, (2) political and personal agenda, (3) cultural belief and practices, (4) concept of time, (5) poor standards, quality, and safety and health, (6) top-down bureaucracy and bureaucratic red tape, (7) lack of technical competence, (8) lack of resources, (9) lack of flexibility and sustainability, and (10) lack of trust and confidence.

Language differences resulting from the mix of various ethnicities is the major cause of communication problems for EMWs (Loosemore and Muslmani, 1999; Phua et al., 2011). Language differences occur between safety management and EMWs or among workers from different ethnicities. Miller et al. (2000) pointed out that EMWs have difficulty in understanding idiomatic languages expressed by native workers, which results in communication barriers between EMWs and their local counterparts. Trajkovski and Loosemore (2006) conducted a survey on the low language ability of EM construction workers and the influence of this problem on their safety and health performance. Their findings revealed that around half of the EMWs surveyed had misunderstood the instructions and most had even made mistakes due to the language barrier. EM construction workers preferred to use their native language rather than the local language, which hampered their development of grasping the local language. Ling et al. (2012) expressed that foreign people in China lack knowledge about the local language, while the majority of Chinese workers are not fluent in English, which gives rise to a communication gap among workers. Guldenmund et al. (2013) stated that many EMWs have grasped some basic native language, but still face problems in comprehension due to dialects or jargon.

However, some researchers found that language differences did not lead to serious consequences. For instance, Ling et al. (2013) investigated the effect of language differences of EM construction workers, such as Chinese, Indians, and Filipinos in Singapore in relation to communication between the project manager and workers. The results indicated that language differences did not result in miscommunication problems between the project manager and EM operatives, as the EMWs in Singapore needed to pass a written examination in English or Mandarin before entering the construction industry and were well-educated.

In addition, Hare et al. (2013) stated that cultural differences lead to the distortion of understanding. According to their study, cultural differences influence employees' understanding of safety related materials and communication ability. Hare et al. (2013) stated that the work experience of workers in construction affects the understanding of safety materials. Those who are less experienced in construction have a lesser ability to identify the safety image compared with those who are more experienced. Their experience in with safety training and risky work may improve their ability to link hazards with the safety images.

2.4.3 Factors affecting effective communication in other settings

The barriers to communication caused by receivers were revealed by Sheldrick-Ross and Dewdney (1998), such as selective perception, making assumptions, giving unsolicited advice, being judgmental, acting defensively, and failing to understand cultural differences.

Torrington and Hall (1998) presented six barriers that could detrimentally influence communication, including the individual's frame of reference, stereotyping, cognitive dissonance, the 'halo or horns' effect, semantics/jargon, and not paying attention.

Huczynski and Buchanan (2001) identified five major factors that influence successful communication, including power differences, gender differences, physical surroundings, language, and cultural diversity.

- Power differences: workers misinterpret communication and believe that supervisors lack adequate understanding of the subordinate.
- Gender differences: male employees are inclined to express themselves, while female employees are inclined to listen and reflect.
- Physical surroundings: problems influencing the effectiveness of communication, such as noisy equipment and room layout.
- Language: issues in language and dialect impede effective communication.
- Cultural diversity: various cultures have different expectations.

2.4.4 Summary of the literature review on communication factors

A total of 42 research articles on safety communication factors in the setting of construction, education, healthcare, and business were reviewed (see Appendix B). As shown in Table 2.3, 36 communication factors were initially summarised. "Language ability of workers", "Adequate understanding of culture in host country", and "Appropriateness of language used by safety staff" were the most frequently mentioned factors in the reviewed literature.

Table 2.3 Communication factors derived from the literature review

Communication factors	Literature in construction	Literature in other settings (e.g., education, healthcare, business)
1. Adequate understanding of culture in host country	Preece and Stocking (1999); Huczynski and Buchanan (2001); Dainty et al. (2007a); Hare et al. (2012)	Wearn et al. (2007); Julliard et al. (2008); Levinson et al. (2008); Hoang et al. (2009); Lonie (2010); Hoang et al. (2009); Keles (2013)
2. Educational level of employee	Preece and Stocking (1999); Dainty et al. (2007a)	Brugge et al. (2009)
3. Cultural and ethnical background of employees	Preece and Stocking (1999); Dainty et al. (2007a); Ejohwomu et al. (2017)	
4. Adequate work experience	Preece and Stocking (1999); Choon Hua et al. (2005)	Mosen et al. (2004); Lonie (2010)
5. Language ability of employees	Loosemore and Muslmani (1999); Phua et al. (2011); Tone et al. (2009); Ejohwomu et al. (2017)	Roberts et al. (2005); Rosenberg et al. (2006); Wearn et al. (2007); Levinson et al. (2008); Julliard et al. (2008); Shahid et al. (2009); Garra et al. (2010); Lonie (2010); Gurnah et al. (2011); Keles (2013)
6. Personality characteristics of employees	Choon Hua et al. (2005); Dainty et al. (2007a); Tone et al. (2009)	
7. Age of workers	Tam et al. (2003); Ejohwomu et al. (2017)	Julliard et al. (2008)
8. Drinking habits of workers	Tam et al. (2003)	
9. Stress and mood of workers	Loosemore et al. (2003); Dainty et al. (2007a)	
10. Not pretending to understand		Park and Song (2005); Julliard et al. (2008)
11. Providing feedback from employees to management	Preece and Stocking (1999); Dickens (2002); Choon Hua et al. (2005)	Rosenberg et al. (2006); (Gurnah et al., 2011)

12. Appropriateness of language used by management	Preece and Stocking (1999); Huczynski and Buchanan (2001); Wong et al. (2004)	Fernandez et al. (2004); Mosen et al. (2004); Williams et al. (2008); Brugge et al. (2009)
13. Appropriateness of communication style of management	Dainty et al. (2007a); Kines et al. (2010)	Shahid et al. (2009); Gao et al. (2009)
14. Avoid using technical terminology and difficult words by management		Browner et al. (2003); Park and Song (2005)
15. Degree of power or status differences between employees and management	Preece and Stocking (1999); Huczynski and Buchanan (2001); Dickens (2002)	Gao et al. (2009)
16. Appropriateness of the amount of information presented at one time		Park and Song (2005)
17. Adequacy of explanations of procedures, rules and policy by management		Cave et al. (1995); Mosen et al. (2004); Park and Song (2005); Shahid et al. (2009)
18. Active and careful listening of management	Ejohwomu et al. (2017)	Levinson et al. (2008)
19. Attitude and mood of management	Choon Hua et al. (2005)	Park and Song (2005); Morinaga et al. (2008)
20. Time constraint of communication		Cave et al. (1995); Mosen et al. (2004); Julliard et al. (2008)
21. Appropriateness of time when information is provided	Emmitt and Gorse (2009)	Williams et al. (2008); Lonie (2010)
22. Workers’ trust in management	Preece and Stocking (1999); Tone et al. (2009); Ejohwomu et al. (2017)	Browner et al. (2003); Weitzman et al. (2004); Gao et al. (2009);
23. Relevance and accuracy of information provided by management	Skyttner (1998)	Williams et al. (2008)
24. Cultural sensitivity and competence of management		Cave et al. (1995); Lingard et al. (2002); Fernandez et al. (2004); Shahid et al. (2009); Keles (2013); Degni et al. (2012)
25. Relationship between supervisors and subordinates		Van Wieringen et al. (2002); Gao et al. (2009); Shahid et al. (2009)

26. Appropriation of communication channel adopted to convey information	Dickens (2002); Dainty et al. (2007a); Lunenburg (2010a); Alsamadani et al. (2013a); Ejohwomu et al. (2017)	
27. Application of pictorial or visual safety materials	Choon Hua et al. (2005); Emmitt and Gorse (2009)	
28. Accuracy of translation by translator or interpreter		Browner et al. (2003); Julliard et al. (2008)
29. Adequacy and appropriation of formal presentation from upper management	Alsamadani et al. (2013a)	
30. Adequacy and appropriation of written communication	Alsamadani et al. (2013a)	
31. Adequacy and appropriation of safety trainings	Graen and Uhl-Bien (1995); Alsamadani et al. (2013a); Tam et al. (2003); Tone et al. (2009)	
32. Adequacy and appropriation of toolbox talks	Graen and Uhl-Bien (1995); Alsamadani et al. (2013a); Tam et al. (2003); Tone et al. (2009)	
33. Organisational support and concern	Dainty et al. (2007a); Emmitt and Gorse (2009); Hurn and Tomalin (2013); Tone et al. (2009)	
34. Time pressure for completion of the project	Wong et al. (2004); Dainty et al. (2007a)	
35. Composition of construction team members	Dainty et al. (2007a); Emmitt and Gorse (2009)	
36. Physical environment such as noisy equipment and room layout	Huczynski and Buchanan (2001); Tam et al. (2003); Dainty et al. (2007a)	

2.5 EFFECTS OF SAFETY COMMUNICATION ON SAFETY PERFORMANCE

In this section, the literature on the relationships among safety communication, safety climate, safety knowledge, safety motivation, safety compliance, and safety participation were reviewed. As shown in Figure 2.3, the integrative model of the effects of safety communication on safety performance was built and modified based on the studies of Neal and Griffin (2006) and Christian et al. (2009) on safety climate, safety knowledge, safety motivation, safety compliance, and safety participation. Safety compliance and safety participation are two leading indicators of safety performance. Safety knowledge and safety motivation are two important mediators.

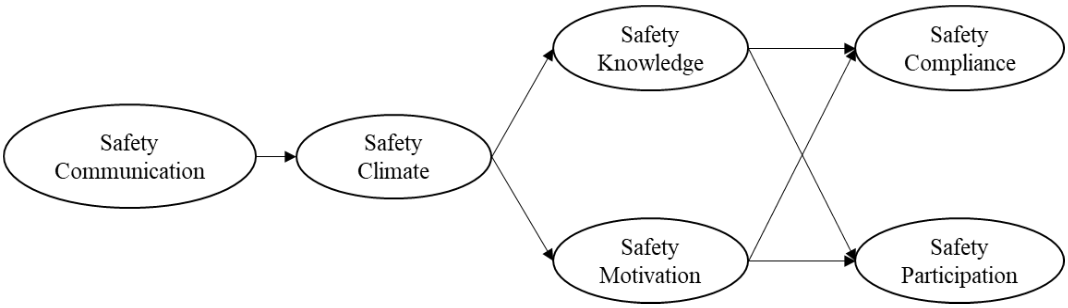

Figure 2.3 An integrative model of effects of safety communication on safety performance

Source: Modified based on the studies of Neal and Griffin (2006) and Christian et al. (2009)

2.5.1Measurement of Safety Performance2

Safety performance is defined as the "action or behaviours that individuals exhibit in almost all jobs to promote the safety and health of workers, clients, the public, and the environment." (Burke et al., 2002, p. 432). The indicators of safety performance can be classified into leading indicators and lagging indicators, as shown in Figure 2.4. Safety performance has traditionally been measured by such indicators as recordable injury rates, the experience modification ratings that are gathered after losses have been incurred, cost assessments have been made, restricted work, or transfer injury rates (Grabowski et al., 2007). These traditionally used indicators are categorised as

[2] Published in Lyu, S., Hon, C.K.H., Chan, A.P.C., Wong, F.K.W., Javed, A.A., 2018. Relationships among safety climate, safety behavior, and safety outcomes for ethnic minority construction workers. *International journal of environmental research and public health*, 15, 484.

lagging indicators, which are related to the outcome of an accident (Hinze et al., 2013). Safety outcome is a tangible and organisational measurement. The lagging indicators of safety performance are mainly based on data related to accidents after the fact and have been considered ineffective and insufficient to provide information for avoiding future accident (Grabowski et al., 2007; Mengolini and Debarberis, 2008; Guo and Yiu, 2013).

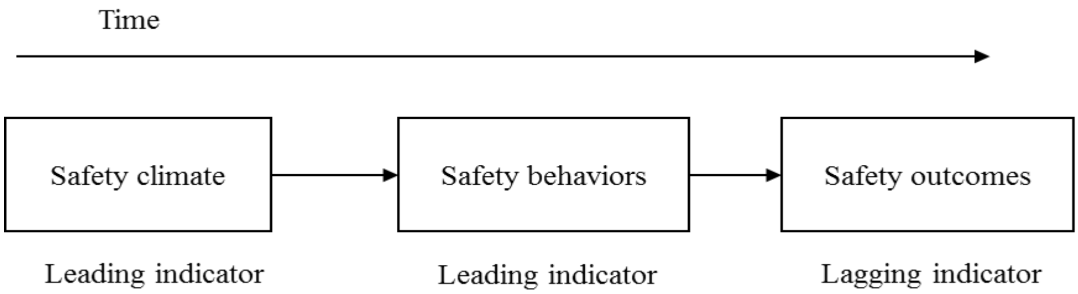

Figure 2.4 Indicators of safety performance

Considering the deficiencies in adopting lagging indicators to measure safety performance, safety behaviours have been recommended by an increasing number of researchers as a proactive measure of safety performance (Cooper and Phillips, 2004). Safety behaviours are actual behaviours that individuals perform at work (Christian et al., 2009). Based on Borman and Motowidlo's (1997) work performance typology, Neal et al. (2000) differentiated safety behaviours into safety participation and safety compliance. These two dimensions have been adopted by many following safety studies, such as Lu and Yang (2010), Vinodkumar and Bhasi (2010), Hon et al. (2014), Seo et al. (2015), Guo et al. (2016), and Zahoor et al. (2017). Safety participation refers to frequent voluntary behaviours that are not likely to promote personal safety directly, but contribute to improving safety in the workplace, such as attending meetings and helping co-workers (Neal and Griffin, 2006). In contrast, safety compliance denotes mandated behaviours that should be conducted to maintain the safety of the workplace, such as wearing personal protective equipment and complying with safety rules and procedures (Neal et al., 2000; Neal and Griffin, 2006).

Another leading indicator of safety performance is safety climate, as it influences safety behaviours, which in turn influence safety outcomes (Neal et al., 2000; Payne et al., 2009) (see Figure 2.3). Drawing on studies of organisational climate, Zohar

(1980) firstly defined the term safety climate. Since then, substantial attention has been paid to the study of safety climate, especially by psychosocial and safety researchers; for example, developing a safety climate instrument, determining the safety climate structure, and analysing the effects of safety climate on other safety related variables. Many studies have identified safety climate factors across various industries (Flin et al., 2000; Glendon and Litherland, 2001; Hon et al., 2014). Nevertheless, there is a lack of consensus regarding the number and structure of safety climate factors. Some review studies have attempted to obtain the common or core safety climate factors through either a qualitative or quantitative approach. For instance, Wu et al. (2015) tested and validated the common safety climate factors identified through a literature review, and finally obtained five core factors (i.e., safety priority, safety supervision, training and communication, safety rules and procedures, and safety involvement). However, disparities and divergences still exist in common safety climate dimensions. This may be due to differences in samples and context, the arbitrariness of naming factors, and differences in measurement instruments. Although consensus on the dimensions of the safety climate has not been reached, the usefulness of safety climate in predicting safety related outcomes is widely recognised in both developing and developed countries. The significant influence of safety climate on accident and injuries has been demonstrated in many empirical studies (Oliver et al., 2002; Seo et al., 2004; Siu et al., 2004; Pousette et al., 2008). These findings indicate that the higher the level of the safety climate, the lower the accident rate. This relationship between safety climate and injuries is mediated by employee's behaviour (Oliver et al., 2002). Safety climate is anticipated to positively affect the safety behaviours of employees. As a result of reward or social exchange theory, a positive safety climate can foster and promote safety behaviours (Neal et al., 2000; Zohar, 2000; Hofmann et al., 2003; Clarke, 2006).

2.5.2 Relationships between Safety Knowledge, Motivation, and Safety Performance

As per job performance theories, individual performance depends on knowledge and motivation (Maier, 1955; Campbell et al., 1993; Guo et al., 2016). Campbell et al. (1993) stated that three determinants of individual performance were declarative knowledge, procedural knowledge and skills, and motivation. In studies of safety, researchers have combined declarative knowledge and procedural knowledge into safety knowledge, and primarily used safety knowledge and safety motivation as the two determinants when analysing safety performance (Neal et al., 2000; Vinodkumar and Bhasi, 2010). *Safety knowledge* refers to “an employee's understanding of safety practices and procedures” (Hofmann et al., 1995). Employees who lack sufficient safety knowledge may not comply with safety regulations and participate the safety activities well (Neal and Griffin, 2002). *Safety motivation* refers to “an individual’s willingness to exert effort to enact safety behaviours and the valence associated with those behaviours” (Neal and Griffin, 2006, p. 947). Employees who have insufficient safety motivation may not comply with safety regulations and participate in safety activities (Neal and Griffin, 2002).

Many researchers have found that safety knowledge and safety motivation are two important determinants of safety performance (Neal et al., 2000; Probst and Brubaker, 2001; Neal and Griffin, 2006). For instance, the longitudinal study of Probst and Brubaker (2001) revealed that safety motivation played a lagged role in safety compliance. In Christian et al.'s (2009) model for workplace safety, safety knowledge and safety motivation were two proximal factors of safety performance and were most strongly related to safety performance. Vinodkumar and Bhasi (2010) found that both safety knowledge and safety motivation could significantly predict safety compliance and safety participation. In the context of construction, Guo et al. (2016) found that both safety knowledge and safety motivation had a positive effect on safety participation rather than safety compliance. Additionally, Neal et al. (2000) stated that safety knowledge was more likely to be related to safety compliance than safety participation, as employees need to have knowledge about how to perform work safely for complying with safety requirements. They also found that safety motivation had a stronger relationship with safety participation than safety compliance.

2.5.3 Relationship Between Safety Communication and Safety Performance

Effective communication is a significant component of safety management practices to improve safety in the workplace (Cox and Cheyne, 2000; Parker et al., 2001; Vredenburgh, 2002; Mearns et al., 2003; Vinodkumar and Bhasi, 2010). Researchers across a wide range of fields have identified the importance of safety communication in safety related issues. For instance, Hofmann conducted some notable studies on safety communication with colleagues. Hofmann and Stetzer (1998) revealed that safety communication had a significant impact on accident attributions. Hofmann and Morgeson (1999) demonstrated that employees with good-quality communication with their management tended to feel free to raise safety concerns, and safety communication significantly affected safety commitment, which further predicted the occurrence of accidents in the manufacturing industry. The findings of Rashid et al. (2014) showed that safety communication positively affected safety commitment and leader-member exchange was a moderator between safety communication and safety commitment. Michael et al. (2006) investigated the effects of safety communication between supervisors and subordinates in wood manufacturing companies and the results showed that safety communication had little direct effect on OSHA recordable injuries.

Recently, there has been an increasing focus on the effects of safety communication in the construction industry. A total of nine studies in the context of construction were identified that examined how safety communication influences safety climate, safety behaviour, and/or safety performance from different perspectives (see Table 2.4). Among these studies, six studies adopted SNA technique to analyse the safety communication issues, including Alsamadani et al. (2013a), Alsamadani et al. (2013b), Liao et al. (2013), Liao et al. (2014a), Albert and Hallowell (2017), and Allison and Kaminsky (2017).

Based on a questionnaire survey administered to union construction workers, Cigularov et al. (2010) found that safety communication was a significant predictor of safety behaviours and work-related pain of workers. Kines et al. (2010) adopted a pre-post intervention-control design with different construction crews and found that if site foremen provided more safety information in daily foreman-worker verbal communication, there would be significant improvement in safety performance of workers.

Table 2.4 Research on safety communication in the context of construction

Researcher	Research area	Research method	Journal
Cigularov et al. (2010)	Safety communication, safety performance and behaviour	Hierarchical linear modelling	*Accident Analysis and Prevention*
Kines et al. (2010)	Verbal safety communication, safety performance and safety climate	Pre-post intervention-control design	*Journal of Safety Research*
Alsamadani et al. (2013a)	Communication and safety performance	SNA	*Construction Management and Economics*
Alsamadani et al. (2013b)	Language proficiency, communication patterns and performance	SNA	*Journal of Construction Engineering and Management*
Liao et al. (2013)	Communication, safety climate and person-organisation fit	SNA	*Journal of Management in Engineering*
Liao et al. (2014a)	Safety communication and safety climate	SNA	*Journal of Civil Engineering*
Liao et al. (2014b)	Safety communication, cognitive failure, and unsafe behaviour	ANOVA, T-test	*Journal of Building Construction and Planning Research*
Albert and Hallowell (2017)	Safety communication patterns and hazard-recognition performance	SNA	*Practice Periodical on Structural Design and Construction*
Allison and Kaminsky (2017)	Female safety communication networks	SNA	*Journal of Construction Engineering and Management*

Alsamadani et al. (2013b) designed a SNA questionnaire and applied SNA to safety communication networks of construction crews in the U.S. Based on a comparison of different construction crews, they found that the frequency and method of safety communication were significant indicators for distinguishing high and low performing teams. Another study by Alsamadani et al. (2013b) explored the connections among personal attributes, safety communication patterns, and safety performance. The researchers revealed that managers were the key persons in safety communication and unilingual crews had a better safety performance than multilingual crews. Furthermore, workers with higher language ability played a significant role in the safety communication of bilingual or multilingual crews, especially in providing safety information.

A series of studies conducted by Liao et al. (2013), Liao et al. (2014a), and Liao et al. (2014b), explored the influences of safety communication on safety climate and unsafe behaviour in construction. Liao et al. (2014a) revealed that higher communication density and degree centrality and lower betweenness centrality which were three main measures of SNA technique could contribute to a more positive safety climate. The relationship between communication and safety climate was found to be mediated by person-organisation fit (Liao et al. (2013). Liao et al. (2014b) further examined the relationships among communication, human cognition, and unsafe behaviour and demonstrated that coaching style (e.g., repeated reminders of safety behaviours) was the most effective communication style to reduce the cognitive failure of construction workers, which would decrease unsafe construction behaviours.

Albert and Hallowell (2017) tested the prediction effect of safety communication patterns on hazard recognition performance using a modified SNA questionnaire designed by Alsamadani et al. (2013a). A denser network, higher in-degree centrality and out-degree centrality of communication was found to significantly predict a better hazard-recognition performance of workers, while betweenness centrality was not a significant predictor. Allison and Kaminsky (2017) explored gender influence on the safety communication of small crews. They also adopted a modified SNA questionnaire derived from Alsamadani et al. (2013a) to collect data from both male and female construction workers. They discovered that females showed lower in-degree and in-closeness compared with males, and mixed-gender crews had sparser formal communication networks but denser informal networks than single-gender crews.

In view of the studies outlined above, it is reasonable to believe that safety communication and the associated communication patterns can affect the safety climate and subsequently workers' safety behaviours and/or performance in work crews. However, there are very few studies on unveiling the safety communication networks of EM crews and their influence on safety related outcomes, which is a rather uncharted area.

2.6 THEORIES REGARDING COMMUNICATION NETWORKS

Homophily indicates the tendency of people to communicate with similar people rather than with dissimilar people (McPherson et al., 2001). How the nature of the tie between a pair of actors can be influenced by the similarity of actors was noticed in 1920s and 1930s. Homophily can be divided into two categories: status homophily and value homophily, as demonstrated by Lazarsfeld and Merton (1954). The former refers to similarity rooted in ascribed status (e.g., race, ethnicity, gender) and acquired status (e.g., religion, education and occupation). The latter denotes the similarity of inner states of individuals, such as values, attitudes, and beliefs. Individuals with higher similarity tend to have stronger ties (Granovetter, 1983). This study aims to investigate the safety communication of EMWs, and therefore focuses on the effects of homophily in race and ethnicity on ties in safety communication networks.

The social exchange theory (Blau, 1964) and the norm of reciprocity (Gouldner, 1960) have been widely employed to explain workers' behaviours in the workplace in many areas (e.g., social power, networks, and leadership) (Cropanzano and Mitchell, 2005). Within social exchange theory, under positive and high-quality exchange relationships, people tend to perceive an obligation and are therefore more likely to reciprocate and perform in ways that benefit their organisation, co-workers, and leaders (Michael et al., 2006). The explanatory roles of social exchange theory in safety related issues have been explored by many researchers. For instance, as two forms of social exchange, perceived organisational support and leader member exchange were found to be positively related to safety communication (Hofmann and Morgeson, 1999).

2.7 STRATEGIES FOR IMPROVING SAFETY COMMUNICATION

Various strategies have been provided by practitioners and researchers to improve communication in the construction industry. For instance, Preece and Stocking (1999) provided some suggestions for improving safety communication in construction, such as encouragement of feedback and use of active listening, regulation of information flow and balancing of repetition, user-oriented communication, appropriate and effective timing of message transmission, and improvement of upward and downward communication.

Loosemore and Lee (2002) found that on the multicultural construction sites of both Australian and Singapore, the most common strategy used by employees to resolve language differences is to communicate through a cultural gatekeeper. They pointed out that this measure has some shortcomings and suggested that the employers could provide language training to both EMWs and indigenous managers and train the safety supervisors and workers to be more culturally sensitive.

Wong et al. (2004) provided some suggestions for the improvement of safety communication between contractors and subcontractors, such as proactive safety management, safety training subsidy, performance evaluation system, overtime and noise control, prioritisation of safety information, determination of appropriate language for communication, and improvement of industry culture.

Vecchio-Sadus (2007) suggested that safety management should be attentive to some issues in order to improve safety communication, such as safety management providing feedback and supervision to workers immediately, identifying a suitable communication channel between safety management and workers, establishing an effective way to collect and communicate safety information, describing safety goals and rules understandably and clearly, and improving listening ability.

Trajkovski and Loosemore (2006) found that many non-English speaking background respondents in the Australian construction industry had difficulties in interpreting instructions onsite and suggested that safety training be provided in their native languages. They also advocated that if language instruction tuition is provided, the content of language instructions should be designed based on the demands of the construction industry. Employers could also translate safety materials (e.g. safety signage, manuals, and risky materials labelling) and adopt more pictorial materials. In addition, in order to make the safety induction course beneficial for EMWs, course trainers should be aware of cultural differences.

According to interviews with 54 EM construction workers in the U.K. who migrated from 16 countries, Dainty et al. (2007b) revealed that the communication barrier is the most serious problem and the main challenge for employing EMWs. They provided some suggestions to improve EMWs' communication, such as identification of the priority language, provision of language training for all EMWs, employment of multilingual safety management, provision of training to the supervisors and induction teams to improve their ability for communication with EMWs, training supervisors and senior management in the priority languages, and translating the safety posters, signage, and other materials into the priority languages.

Bust et al. (2008) proposed some measures that can be taken to improve the safety communication of EMWs, including grouping workers using the same language into one team and arranging one ganger who could speak the native language as the translator, pairing one EM worker with one local worker, the employment of an onsite interpreter, translation of safety materials into the EM's native language, provision of local language training courses, as well as adoption of pictorial approaches.

Han et al. (2008b) suggested that communication manuals and safety methods could be developed and prepared in the EM's native language. Audio or visual media could be adopted to facilitate EMWs to understand the work procedures. EM supervisors or middle-level superintendents who are familiar with the local culture and can speak the local language are highly recommended to be the bridge between local senior management and EMWs. They also highlighted the role of preliminary and periodic education in improving the communication performance of EMWs.

Tutt et al. (2011) believed that site induction is vital for EMWs to receive useful safety messages but should not over rely on standard training devices that could hinder the communication of site-specific knowledge. They believed that local language training is effective for EMWs to understand the main safety and health message if it is conducted in a way that is appropriate for the workers.

Guldenmund et al. (2013) stated that safety management should communicate the safety message clearly to EMWs and suggested that EMWs should learn some local language so that they can comprehend safety instructions and warn their local co-workers about risks or be warned.

Kaskutas et al. (2013) investigated the impact of safety training in safety communication on the safety of workers. They found that after piloting the designed safety training with foremen, toolbox talks and mentoring became more frequent and interactive, which led to the improvement of safety behaviour. They suggested that the leaner-centred training for foremen would improve the safety communication onsite. The empirical study conducted by Olson et al. (2016) was targeted to analyse the role of toolbox talks of safety communication to prevent construction fatalities. The brief scripted toolbox talks were preferred by safety supervisors. They suggested that safety materials for toolbox talks be easy for supervisors to communicate fatal cases and prevention measures to their workers.

The limitations of these measures have been pointed out by some researchers. For instance, the quality of the translation of safety materials is questionable, and some safety materials translated in the EM's native language are still difficult for EMs to understand due to their low level of literacy and lack of professional knowledge (McKay et al., 2006; Bust et al., 2008). When onsite translators are not nearby and the number of translators is insufficient for EMs, translators could not provide effective service to EMWs. Technical terms are also an obstacle for the translators. Training EMWs to learn the local language requires an enormous amount of time and cost; while the job demands and the movement between jobs influences their attendance of language training opportunities (Guldenmund et al., 2013).

2.8 CHAPTER SUMMARY

This chapter summarised the results of the literature review regarding the safety and health problems of EM construction workers; communication theories (e.g., definition of communication and safety communication; theoretical models for communication, and key elements of the communication process); communication factors (e.g., factors influencing communication in construction and other settings); measurement of safety performance; the relationship between safety knowledge, motivation, and safety performance; theories related to the communication network; and strategies for safety communication improvement.

Chapter 3: Research Methodology

3.1 INTRODUCTION

This chapter explains the research methodology and strategies adopted to achieve the objectives of this study. Both qualitative and quantitative research methods are employed in this study, such as a literature review, semi-structured interviews, Delphi survey, and a questionnaire survey.

3.2 RESEARCH FRAMEWORK OF THE STUDY

After reviewing the literature on the safety and health problems of EMs, communication theory; communication factors; and the relationships between safety communication, and safety performance, a mixed-research method was adopted in the current study to achieve the seven objectives. A qualitative research method involving semi-structured interviews and a quantitative research method involving a Delphi survey and questionnaire survey were carried out. The research process for the study is depicted in Figure 3.1.

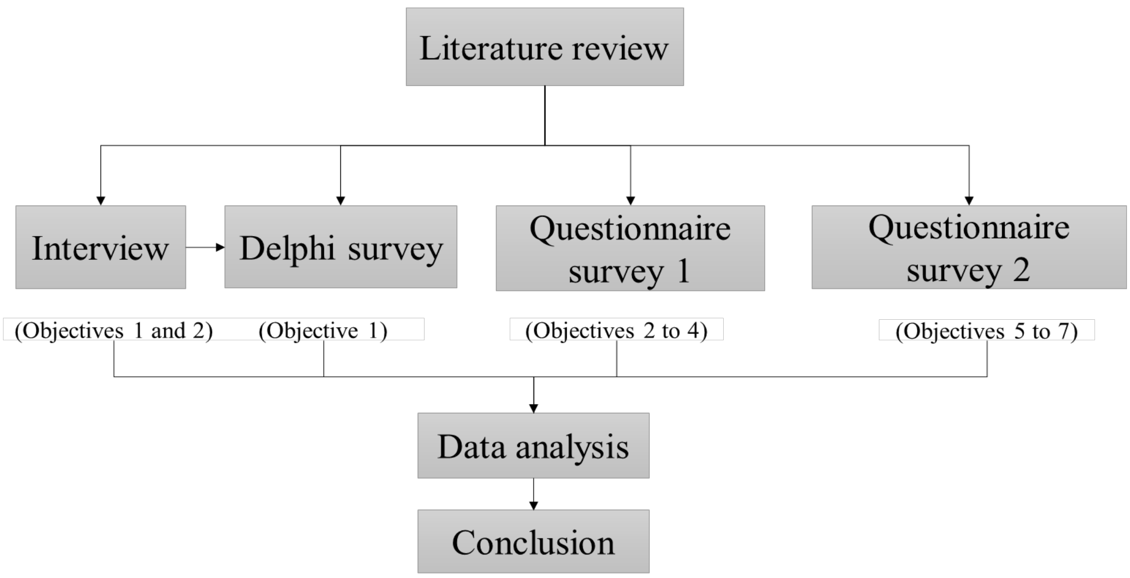

Figure 3.1 Research process of the study

Firstly, a qualitative research method in the form of interviews was applied to obtain an enhanced understanding of the safety and health problems of EMWs (Objective 1) and safety communication factors (Objective 2), because safety information targeting the EM group was insufficient. The details of the semi-structured interviews are explicated in Section 3.3.1.

Secondly, a two-round Delphi survey was carried out to rank the safety and health problems of EM construction workers derived from the interviews (Objective 1). Details of the Delphi survey are described in Section 3.3.2. Kendall's coefficient of concordance analysis, Spearman rank-order correlation analysis, and marginal homogeneity tests were applied to analyse the data collected from two rounds of Delphi survey (the descriptions of these statistical analysis approaches can be found in Sections 3.3.3, 3.3.4, and 3.3.5).

Thirdly, questionnaire survey 1 was carried out to identify the critical safety communication factors of EMs (Objective 2), establish the relationship between the safety communication factors and safety performance of EMs (Objective 3), and compare the safety communication factors among EMs, management staff, and local workers (Objective 4). The design of the questionnaire and data collection for survey 1 are discussed in Sections 3.4.2 and 3.4.3, respectively. To analyse the data collected from questionnaire survey 1, the mean scoring technique and exploratory factor analysis were employed to achieve Objective 2 (see Section 3.4.4); structural equation modelling, evaluation of validity, and importance-explanation analysis were conducted for Objective 3 (see Section 3.4.5); and Kendall's coefficient of concordance analysis, Spearman rank-order correlation analysis, and independent sample *t*-test were adopted to achieve Objective 4 (see Section 3.4.6).

Lastly, questionnaire survey 2 was conducted to build the predominant safety communication structures of EM crews (Objective 5), evaluate the safety communication structures of EMs (Objective 6), and investigate the relationship between the safety communication structures and safety performance of EMs (Objective 7). The design and data collection for questionnaire survey 2 are explicated in Sections 3.5.1 and 3.5.2, respectively. Various quantitative methods for data analysis were also adopted to analyse the data collected from questionnaire survey 2, including social network analysis, Mann-Whitney *U* test, and Kruskal-Wallies *H* test.

3.3 RESEARCH STRATEGIES FOR OBJECTIVE 1[3]

3.3.1 Semi-structured interviews

Face-to-face semi-structured interviews were conducted to collect data for the Objective 1. Interviews delve deeply into the views of interviewees on the targeted issues (Charmaz, 2014). There are three types of interview: semi-structured, structured, and unstructured. A semi-structured interview was used as it can provide a high degree of flexibility during the interviews (Ochieng and Price, 2010). The number of interviews to be conducted was dependent on saturation of categories when no new category emerged. All the interview dialogues were audio-taped and transcribed verbatim for data analysis with permission of the respondents.

In order to identify the safety and health problems, safety communication factors, current safety communication structures, and strategies to improve their safety communication, contractors were first targeted for face-to-face semi-structured interviews because they were more likely to have hands-on and direct work experience with EM construction workers. Other stakeholders were also invited to provide a balanced view. As shown in Table 3.1, a total of 18 senior management professionals representing a wide range of construction experts (12 from contractors, two from government organisations, two from quasi-government organisations, one client, and one from a construction material company), participated in interviews. All interviewees were involved in managing EMWs. The majority of respondents were at a managerial level and a few held frontline supervisory positions.

The average duration of the interviews was approximately 80 minutes (ranging from 60 to 90 minutes). The interviews included three parts. In part A, the research aim and significance were briefly introduced to interviewees. In part B, the preliminary findings from the literature review were shown to respondents for reference. In part C, all of the interviewees were asked the pre-drafted interview questions, as shown in Appendix C, and they could provide their spontaneous comments flexibly. The interview dialogues were audio-taped and transcribed verbatim for data analysis with

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[3] Published in Chan, A.P.C., Wong, F.K.W., Hon, C.K.H., Javed, A.A., Lyu, S.*, 2017. Construction safety and health problems of ethnic minority workers in Hong Kong. *Engineering, Construction and Architectural Management*, 24, 901-919.

permission of the respondents. Most of the interviews were conducted in English and a few were conducted in Cantonese (a Chinese dialect commonly spoken in Hong Kong). The interviews in Cantonese were translated into English during the transcription of the dialogues. Each transcript was scrutinised by fellow researchers and verified by the respondents.

Table 3.1 Background of the interviewees

No.	Position of interviewees	Nature of organisation
A	Operational Safety Director	Contractor
B	Safety & Environment Manager	Contractor
C	President	Quasi-government
D	Safety Officer	Contractor
E	Director Safety Manger	Contractor
F	Health, Safety and Compliance Support Manger	Contractor
G	Group HSEQ Manager	Contractor
H	Engineer/Safety & Environmental Advisor	HKSAR government
I	Senior Manager/Safety & Health	HKSAR government
J	Director	Contractor
K	Senior Safety Manager	Contractor
L	Project HSEQ Manager	Contractor
M	Senior HSEQ Manager	Construction material company
N	Deputy General Manager-Safety & Security	Client
O	Consultant	Quasi-government
P	Construction Safety Engineer	Contractor
Q	Director	Contractor
R	Manager-Project Safety	Contractor

Data analysis was concurrent with data generation. This overlap allowed for modifications to the data generation process in view of emerging concepts. Qualitative analysis software QSR NVivo 10 (QSR International 2015) was used to aid the coding process (Strauss, 1998). The constant comparison method was also applied to establish analytic distinctions (Birks and Mills, 2011). In the first step, comparison was conducted within one single interview to identify similarities. In the process of open coding of data, the transcript was fractured and analysed sentence by sentence, and the statements with similar semantic meanings were coded as the same category (Boeije, 2002). Two researchers analysed the interview transcriptions separately without a prearranged coding structure to reduce prejudice. In the second step, comparisons between interviews were carried out as soon as more than one interview was conducted. after open coding, axial codes were constructed to determine the clear and distinct categories until no more codes needed for covering all relevant themes (Boeije, 2002). The identified safety and health problems in this section will be assessed by Delphi survey in the next section to determine the relative severity.

3.3.2 Two rounds of Delphi survey

A two rounds of Delphi survey were applied for evaluating the relative severity of the safety and health problems of EMWs identified by semi-structured interviews. Although a traditional questionnaire survey can be used to collect statements from an expert panel, the Delphi method has been proven to be a more suitable method for prioritising issues (Linstone and Turoff, 1975; Schmidt et al., 2001). This approach is especially necessary when academic studies are insufficient compared with the rich knowledge acquired by senior management managing EMWs (Yeung et al., 2009).

To select appropriate expert members for the Delphi expert panel is the most important step in the Delphi survey as it directly influences the validity of the research results. In the current study, the safety and health problems faced by EMWs were different from those faced by their local counterparts. Therefore, professionals who met the following two criteria were selected as members of the expert panel. First, they toned to have rich work experience in the Hong Kong construction industry. Second, they need to have diverse work experience in managing EMWs.

More than 50 professionals who worked in contractors, clients, and consultancy companies were invited to participate in the Delphi survey. A total of 18 experienced senior management professionals satisfied all the aforementioned selection criteria, as shown in Table 3.2. Their positions included project managers ($N = 5$), site engineers ($N = 4$), project directors ($N = 3$), assistant project managers ($N = 3$), contract managers ($N = 2$), and a service manager ($N = 1$). Among these members, 33% ($N = 6$) had over 20 years of work experience in the construction industry, 33% ($N = 6$) had 11 to 20 years, 17% ($N = 3$) had six to 10 years, and 17% ($N = 3$) had less than five years. All experts were involved in managing EM construction workers from various countries, such as Nepal, Pakistan, the Philippines, Vietnam, and India. Thus, the selected experts with senior positions, rich work experience in the construction industry, and management experience with EMWs were knowledgeable enough to provide a reliable view and ensure the validity of the Delphi survey.

Table 3.2 Background of expert panel of Delphi survey

No.	Position	Organization	Work experience in construction	Nationality of EMs
1	Contracts Manager	Contractor	> 20 years	Indian
2	Director	Contractor	> 20 years	Nepalese, Pakistani, Philippine, Indian
3	Service Manager	Contractor	16 − 20 years	Nepalese
4	Project Manager	Contractor	6 − 10 years	Nepalese, Pakistani, Philippine
5	Project Officer	Client	11 − 15 years	Nepalese, Pakistani
6	Project Manager	Contractor	> 20 years	Pakistani
7	Engineer	Contractor	1 − 5 years	Nepalese
8	Project Manager	Contractor	16 − 20 years	Nepalese, Pakistani, Philippine, Indian, Vietnamese
9	Assistant PM	Contractor	16 − 20 years	Nepalese
10	Project Director	Contractor	> 20 years	Nepalese, Philippine
11	Director	Contractor	> 20 years	Pakistani
12	Contracts Manager	Contractor	>20 years	Nepalese
13	Project Manager	OHS consultant body	16 − 20 years	Nepalese, Pakistani, Philippine
14	Assistant Project Manager	Contractor	6 − 10 years	Nepalese
15	Assistant Project Manager	Client	1 − 5 years	Nepalese, Pakistani
16	Site Engineer	Contractor	6 − 10 years	Nepalese
17	Senior Engineer	Contractor	16 − 20 years	Nepalese, Pakistani, Korean
18	Site Agent	Contractor	1 − 5 years	Pakistani

The Delphi survey approach originally consists of four rounds (Young and Hogben, 1978). It has been modified and refined into two to three rounds to fit individual research purposes in some studies (Hon et al., 2010; Hon et al., 2012). In addition, To maintain a high response rate is difficult to achieve in a Delphi survey with many rounds (Manoliadis et al., 2006). Therefore, this study adopted a two-round Delphi survey. In the first round, all experts were requested to rate the relative severity of safety and health problems of EMWs on the basis of a five-point Likert scale. In the second round, the results of the first round were analysed and returned to all of the panel members. They were then requested to reconsider and re-evaluate the ratings of the safety and health problems of EMWs. All respondents were kept anonymous to each other during the entire process. Once all questionnaires were collected, the questionnaire data were analysed by Kendall's coefficient of concordance, Spearman rank-order correlation and Marginal homogeneity test.

3.3.3 Kendall's coefficient of concordance W

Kendall's coefficient of concordance *W* (aka Kendall's *W*) is a non-parametric measure used to assess the agreement among raters. Kenall's *W* is calculated using the below formula (Siegel and Castellan, 1988):

$$\mathrm{W} = \frac{\sum_{i=1}^{n}(R_i-\overline{R_i})^2}{\frac{1}{12}m^2(n^3-n)} = \frac{\sum_{i=1}^{n}R_i^2-\frac{1}{n}\left(\sum_{i=1}^{n}R_i\right)^2}{\frac{1}{12}m^2(n^3-n)} \quad (1)$$

Where,

m = the number of raters;

n = the number of objects being rated;

R_i = sum of the ranks assigned to the i^{th} object.

If ties exist in a set of data, the adjustment of the aforementioned equation of Kendall's *W* to a tied-corrected version is suggested, as follows:

$$W_c = \frac{S}{\frac{1}{12}[m^2(n^3-n)-m\mathrm{T}]} \quad (2)$$

Where,

$\mathrm{T} = \sum_{k=1}^{\mathrm{g}}(t_k^3 - t_k)$;

t_k = the number of tied ranks in the *k*th group of g groups of ties.

The values of *W* range from 0 to 1, with 1 representing a perfect concordance and 0 representing no agreement. It is noted that Kendall's *W* is applicable when the number of objects $n \leq 7$. If $n > 7$, the use of chi-square χ^2 is recommended and computed for a near approximation of Kendall's *W,* as follows (Sheskin, 2003):

$$x^2 = m(n-1)W \quad (3)$$

The computed chi-square χ^2 value needs to be compared with critical chi-square χ^2 value, which can found in the table of critical values of chi-square distribution (Siegel and Castellan, 1988). If the computed chi-square χ^2 value is equal to or larger than critical chi-square χ^2 value, the null hypothesis can be rejected, indicating that a consensus among the respondents exists in relation to how they have ranked objects.

Kendall's coefficient of concordance was used in analysing data collected from two rounds of Delphi survey to test the agreement of experts' perceptions on the SC factors of EMs in two rounds. The null hypothesis H_0 is stated as *"There is no correlation among ranks assigned by the experts from two rounds of Delphi survey"*, and the alternative hypothesis H_0 is *"There is correlation among ranks assigned by the experts from two rounds of Delphi survey"*.

3.3.4 Spearman rank-order correlation analysis

Spearman's correlation (r_s) is a nonparametric measure of the strength and direction of association between two ranked variables (Sheskin, 2003). This test has been wildly used in studies on construction management. For instance, this tool was used this to compare rankings of the risk factors (Chan et al., 2011) and critical success factors (Chan et al., 2010) for target cost contracts construction projects. Ng et al. (2012) adopted this technique to evaluate the association of the rankings by the public sector, private sector, and general community on factors influencing the success of public-private partnership projects at the feasibility stage. In this study, Spearman's correlation of the rankings between the first and second round of the Delphi survey was computed to evaluate the consistency of the experts. Spearman's correlation (r_s) is calculated using the below formula (Norušis, 2012):

$$r_s = 1 - \frac{6\sum d_i}{n(n^2-1)} \quad (4)$$

Where,
d_i = the difference between the paired ranks of each variable;
n = the number of cases.

The value of coefficient r_s ranges from -1 to +1. The value r_s of +1 indicates a perfect association of ranks, the value r_s of 0 indicates no association between ranks, and a value r_s of -1 indicates a perfect negative association of ranks. The absolute value of r_s approaching 1 denotes a strong relationship among two groups.

3.3.5 Marginal homogeneity test

A marginal homogeneity test is a non-parametric significance test for two dependent samples to assess the rater agreement of each rating category (Sheskin, 2003). The marginal homogeneity test generalises the McNemar test from binary data to multiple ordinal data. Compared with the McNemar test, the marginal homogeneity test is suitable for samples with more than two categories. The differences in the ranking of each safety problem between the first and second Delphi rounds were analysed using the non-parametric marginal homogeneity test, considering that the samples were dependent. A 0.05 probability was considered statistically significant.

3.4 RESEARCH STRATEGIES FOR OBJECTIVE 2, 3, 4

3.4.1 The development of research model and hypotheses

Based on the literature review in Chapter 2, a theoretical research model was proposed to investigate the relationships among safety communication factors, safety knowledge, safety motivation, safety participation, and safety compliance (see Figure 3.2). This model was built based on Neal and Griffin (2006) on safety climate, safety motivation, safety behaviour, and accidents. In this study, safety communication factors, safety knowledge, safety motivation, safety participation, and safety compliance were latent variables.

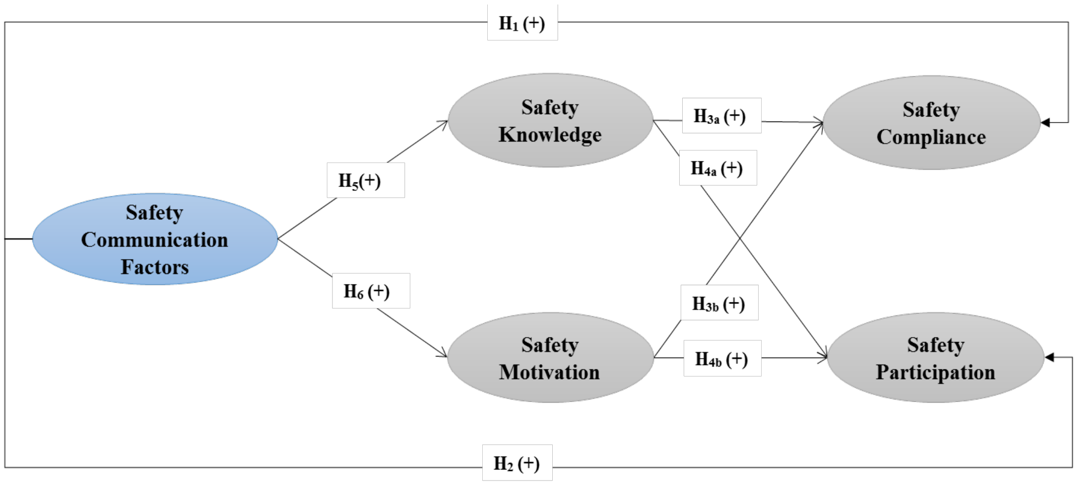

Figure 3.2 The proposed conceptual model and hypotheses

As an important component of safety management, safety communication can directly affect the safety performance of employees in an organisation. If employees have effective communication about safety issues with management and co-workers they are more likely to comply with safety regulations and procedures and attend to safety activities. Thus, the first two hypotheses were proposed as follows:

- Hypothesis 1 (H_1). Safety communication factors have a positive direct effect on safety compliance.
- Hypothesis 2 (H_2). Safety communication factors have a positive direct effect on safety participation.

The below hypotheses regarding the connections between safety motivation, safety knowledge, and safety performance were proposed:

- Hypothesis 3a (H_{3a}). Safety knowledge has a positive direct effect on safety compliance.
- Hypothesis 3b (H_{3b}). Safety motivation has a positive direct effect on safety compliance.
- Hypothesis 4a (H_{4a}). Safety knowledge has a positive direct effect on safety participation.
- Hypothesis 4b (H_{4b}). Safety motivation has a positive direct effect on safety participation.

The relationship between safety communication and safety performance may be mediated by safety knowledge and safety motivation; thus:

- Hypothesis 5 (H_5). Safety communication factors have a negative indirect effect on safety compliance.

- Hypothesis 6 (H_6). Safety communication factors have a negative indirect effect on safety participation.

3.4.2 Design of questionnaires for survey 1

Two sets of questionnaires were designed for construction workers and management staff, respectively, in questionnaire survey 1 (see Appendix E). The first questionnaire was designed for both EM and local construction workers to identify the critical safety communication factors and investigate the direct and indirect effects of critical safety communication factors on the safety performance of EM and local construction workers. It consisted of three parts: personal attributes, safety communication factors, and safety performance. The second questionnaire was designed for management staff to identify the critical safety communication factors of EMs from the perspective of management staff. The second questionnaire included two parts: the personal attributes of management staff and safety communication factors. The instrument used to evaluate the safety communication factors in the two questionnaires was the same.

3.4.2.1 Design of instrument to evaluate safety communication factors

As there was no questionnaire regarding safety communication factors available for construction workers, this study designed a new instrument for safety communication factors based on the literature review, semi-structured interviews, and expert consultation. The development of the instrument involved three stages.

Stage 1: Literature review

Studies on communication in the settings of construction management, business, health care, social science, and education were reviewed. Safety communication factors with similar meanings were renamed and classified together. As shown in Table 2.3, a total of 36 original safety communication factors that influence the effectiveness of communication were identified based on the literature review.

Stage 2: Semi-structured interviews with management

A total of 18 face-to-face semi-structured interviews were conducted with professionals in the Hong Kong construction industry. The positions of the interviewees were mainly directors, safety and health managers, safety officers, and gangers. Four questions were asked during the semi-structured interviews, as follows:

- What are the key factors of safety communication for EMWs?
- What are key success factors of effective safety communication of EMWs?
- What are the major safety communication problems of EMWs?
- What measures should be taken to improve the safety communication of EMWs?

Fourteen distinct safety communication factors for EMs were identified according to the results of the interviews, as shown in Table 3.3. Among the14 factors, 13 factors were consistent with the factors derived from the literature review and one additional factor “Employment of staff from EM worker’ country” was not revealed by the literature, resulting in 37 SC factors. Factors with similar meanings to those identified from literature review are marked by ticks in Table 3.4.

Stage 3: Expert evaluation

The 37 safety communication factors were sent to three experts to examine the content validity: two researchers who had more than ten years of experience studying the occupational safety and health of workers and construction management, and one professional who had more than ten years of work experience in the construction industry. According to the comments from the experts, two items with the similar meaning were combined: “Not pretending to understand” and “Providing feedback from employees to management”. In addition, some of the modifications made by experts are highlighted in Table 3.4. Thus, a total of 36 safety communication factors were determined after three stages.

Table 3.3 Safety communication factors identified from interviews

No.	SC factors	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Education level of EMs											√							
2	Language ability of EMs		√	√	√	√		√	√	√				√	√	√		√	√
3	Language and dialect used by management			√	√								√						√
4	Providing feedback from EMs to management													√					
5	Adequacy and appropriateness of safety training	√		√									√					√	√
6	Adequacy and appropriateness of written communication	√								√									
7	Appropriateness of communication channel adopted to convey information									√									
8	Employment of staff from EM worker' country	√				√	√						√	√				√	√
9	Accuracy of translation by translator or interpreter										√								√
10	Appropriateness of communication style of management				√														
11	Composition of construction team members	√																	
12	Adoption of pictorial or visual safety materials		√	√						√				√				√	
13	Stress and mood of workers																	√	
14	Not pretending to understand													√					

Table 3.4 Modifications made by experts

Original communication factors identified from		Modified communication factors by experts
Literature review	Interview	
1. Adequate understanding of culture in host country		1. Adequacy of workers' understanding of culture in host country
2. Educational level of ~~employee~~	√	2. Sufficient educational level of workers
3. Cultural and ethnical background of employees		3. Cultural and ethnical background of workers
4. Adequate work experience		4. Adequacy of workers' work experience in construction
5. Language ability of employees	√	5. Adequacy of language ability of workers
6. Personality characteristics of employees		6. Personality characteristics of workers
7. Age of workers		7. Age of workers
8. Drinking habits of workers		8. No drinking habits of workers
9. Stress and mood of workers	√	9. Good emotional state of workers
~~10. Not pretending to understand~~	√	
11. Providing feedback from employees to management	√	10. Providing feedback from workers to management
12. Appropriateness of language used by management	√	11. Appropriateness of language used by management
13. Appropriateness of communication style of management	√	12. Appropriateness of communication style of management
14. Avoid using technical terminology and difficult words by management		13. Avoiding using too much technical terminology and difficult words by management
15. Degree of power or status differences between ~~employees~~ and management		14. Degree of power or status differences between construction workers and their management staff
16. Appropriateness of the amount of information presented at one time		15. Appropriateness of the amount of safety information presented at one time by management
17. Adequacy of explanations of procedures, rules and policy by management		16. Adequacy of explanations of procedures, rules and policy by management
18. Active and careful listening ~~of management~~		17. Active and careful listening to workers
19. Attitude and mood of management		18. Good attitude and mood of management
~~20. Time constraint of communication~~		19. Adequacy of time when communicating with workers
21. Appropriateness of time when information is provided		20. Appropriateness of time when safety information is provided
~~22. Workers' trust in management~~		21. Building trust within the team

23. Relevance and accuracy of information provided by management		22. Relevance and accuracy of safety information provided by management
24. Cultural sensitivity and competence of management		23. Cultural sensitivity and competence of management
~~25. Relationship between supervisors and subordinates~~		24. High quality of supervisor-subordinate relationship
26. Appropriation of communication channel adopted to convey information	√	25. Appropriateness of communication channel adopted to convey safety information
	27. Employment of staff from ~~EM~~ worker' country	26. Employment of safety staff from workers' origin country
28. Application of pictorial or visual safety materials	√	27. Application of pictorial or visual safety materials
29. Accuracy of translation ~~by translator or interpreter~~	√	28. Accuracy of translations of safety messages
30. Adequacy and appropriation of formal presentation from upper management		29. Adequacy and appropriateness of formal presentation from upper management
31. Adequacy and appropriation of written communication	√	30. Adequacy and appropriateness of written communication
32. Adequacy and appropriation of safety trainings	√	31. Adequacy and appropriateness of safety trainings
33. Adequacy and appropriation of toolbox talks		32. Adequacy and appropriateness of toolbox talks
34. Organizational support and concern		33. Organizational support and concern
35. Time pressure for completion of the project		34. No much time pressure for completion of the project
36. Composition of construction team members	√	35. Appropriate composition of construction team members
37. Physical environment such as noisy equipment and room layout		36. Appropriateness of physical environment

Note: The deletions made by experts are highlighted by a strikethrough and the additions made by experts are marked by underline. The ticks represent that the factors identified in the interviews had similar meaning to those identified by the literature review.

3.4.2.2 Description of questionnaire for EM and local workers

The first questionnaire in survey 1 was administered to local and EM construction workers in both Hong Kong and Australia. It included four sections: 17 questions regarding the respondent's background (Section A), 36 questions regarding factors that may affect the effectiveness of safety communication (Section B), and 12 questions regarding measures of safety performance (Section C).

- Section A collected the respondents' personal information, including country of origin; work trade; age; work experience in construction; education level; direct employer; length of service with the current project; language fluent in and languages used for written material, safety training, and meetings; and the number of accidents and occupational injuries.

- Section B consisted of 36 items related to the safety communication factors derived from literature review, semi-structured interviews, and expert evaluation. The respondents were asked to rate the importance of these factors in improving their safety communication using a five-point Likert scale, where 1 = not important; 2 = slightly important; 3 = moderately important; 4 = important; 5 = very important.
- Section C solicited data related to the safety knowledge (3 questions), safety motivation (3 questions), safety compliance (3 questions), and safety participation (3 questions) of the construction workers. All of the questions were derived from previous studies in which the reliability and validation were tested, as shown in Table 3.5. All four constructs were under the same heading "Please select the most appropriate boxes to show your level of agreement (1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 =agree; 5 = strongly agree)".

Table 3.5 Construct measurement for safety performance

Constructs	Question number	Supporting literature
Safety knowledge	3	(Neal et al., 2000), (Vinodkumar and Bhasi, 2010), (Guo et al., 2016), (Shen et al., 2017)
Safety motivation	3	(Neal et al., 2000), (Vinodkumar and Bhasi, 2010), (Shen et al., 2017)
Safety compliance	3	(Neal et al., 2000), (Vinodkumar and Bhasi, 2010), (Shen et al., 2017)
Safety participation	3	(Neal et al., 2000), (Vinodkumar and Bhasi, 2010), (Shen et al., 2017)

- **Safety knowledge.** It reflected the degree to which construction workers were knowledgeable about safety practices and procedures (Shen et al., 2017). Three statements were adopted from the study of by Neal et al. (2000). An example statement was, "I know how to use safety equipment and standard work procedures".
- **Safety motivation.** The construct of safety motivation reflected the degree to which construction personnel were inclined to perform tasks in a safe

manner (Shen et al., 2017). Three statements were adopted from the study of Neal et al. (2000). An example statement was, “I feel that it is important to encourage others to use safe practices”.

- **Safety compliance.** It reflected the degree to which construction personnel were compliant with safety rules and procedures (Shen et al., 2017). Three statements were adopted from the study of Neal et al. (2000). An example statement was, “I follow correct safety rules and procedures while carrying out my job”.
- **Safety participation.** It reflected the degree to which construction workers participated in safety-related activities (Shen et al., 2017). Three statements were adopted from the study of Neal et al. (2000). An example item was, “I put extra effort to improve the safety of the workplace”.

3.4.2.3 Description of questionnaire for management staff

The second questionnaire in survey 1 was designed for management staff in both the Hong Kong and Australian construction industry. It included two sections: seven questions regarding the respondents’ background (Section A) and 36 questions regarding factors that may affect the effectiveness of safety communication of EM construction workers (Section B).

- Section A solicited respondents’ personal information, consisting of position, country of origin, work experience in the construction industry, current professional affiliation, educational level, language fluent in, and work experience with EM construction workers.
- Section B consisted of 36 items of safety communication factors of EMs, which were almost the same as those in the questionnaire for the construction workers. In these items, workers were changed to EM construction to make them specifically refer to EMWs. In this section, management staff were asked to rate the importance of each factor in improving the safety communication of EM construction workers.

3.4.3 Data collection of questionnaire survey 1

The first questionnaire for survey 1 was administered to EM and local construction workers and the second was distributed to management staff working in civil and building projects in Hong Kong and Australia. Similar to the situation in Hong Kong, a large proportion of EM construction workers are employed in the Australian construction industry. Approximately 20% of the construction workforce in Australia are from overseas and nearly half are born in non-English speaking countries (Department of Immigration and Citizenship, 2009). Thus, collecting data from EM construction workers in Australia was deemed necessary. The questionnaires were initially prepared in English and Chinese. For the convenience of frontline EMWs, the questionnaires for EMWs were further translated into Nepali (for Nepalese workers), Urdu (for Pakistani workers), and Korean (for South Korean workers) by professional translation companies. The translated questionnaires were reviewed by researchers who are native speakers and obtained the PhD degree in construction management to ensure the accuracy of translations. Questionnaires for management staff were prepared in English and Chinese. Formal ethics approval was obtained from the researcher's institutions. A pilot study was conducted with two academic staff, eight practitioners, and 10 construction workers, following which modifications were made to the format and descriptions of several items. All respondents were informed that the survey was anonymous, and the collected data would be analysed and reported collectively for academic purposes.

A convenience sampling method was applied for questionnaire survey 1. Convenience sampling (also known as availability sampling) is a method that the selection of participants is dependent on their ready availability (Frey, 2018). Considering that there is no exhaustive list of the studied population in both Hong Kong and Australia, convenience sampling is more suitable for this study. As stated by Gravetter and Forzano (2018), this sampling approach is predominantly used in the behavioural sciences, which is regarded as easier, less expensive, and more timely compared with a random sampling method. The common flaws with the convenience sampling method are that sample is not randomly selected and is probably biased. To compensate for the lack of randomisation, a high degree of diversity of respondents was achieved; that is, different ages, different education levels, different work experience in construction, and different length of service with the current company; and as such, the collected sample is reasonably expected to be a convincing cross-section sample of the whole population (Gravetter and Forzano, 2018).

Invitation letters which explained the objective of the research and the targeted respondents were sent to around 60 construction companies via emails to seek their permission to conduct questionnaire survey. A total of 12 construction companies in Hong Kong and 10 construction companies in Australia agreed to participate in this survey. To avoid clustering within specific construction sites, the employers were advised to randomly select approximately 20 workers from the roster at each site to participate in this survey. In addition, some measures were taken to ensure a high response rate by respondents in order to produce a valid and reliable result. Firstly, the researcher communicated with the management of the construction companies about the process for the questionnaire survey prior to the distribution of the questionnaires through face-to-face discussions, emails, or telephone conversations. Secondly, the summary of research findings was provided to management staff and the chance to win prizes was offered to construction workers as incentives for the respondents. It was demonstrated that incentives have no effect on response quality of questionnaire survey (Gritz, 2004; James and Bolstein, 1990; Shettle and Mooney, 1999; Teisl et al., 2005). Lastly, reminders were sent regularly to some respondents whose questionnaires were not collected face-to-face.

The summary of data collected from the questionnaires is listed in Table 3.6. The total number of questionnaires distributed to EM frontline workers, local frontline workers, and management staff were 200, 300, and 150, respectively. A total of 150, 228, and 106 questionnaires were collected from EMWs, local workers, and management staff, and the overall response rate was 75%, 76%, and 80%, respectively. The overall response rate was 74%. These response rates were achieved by follow-up emails and calls.

Because of missing or incomplete data (missing data >10%) and a high percentage of the same answers, 16, 26, and 11 questionnaires from EMs, local workers and management staff were deleted, and 134, 202, and 95 valid questionnaires from EMs, local workers, and management remained. The valid response rate was 67%, 67%, and 63% for EMs, local workers, and management. The overall valid response rate was 66%.

Table 3.6 Number of questionnaires collected from respondents

Groups	EMs			Local workers			Management staff			Total
	HK	AU	Total	HK	AU	Total	HK	AU	Total	
Questionnaires distributed	100	100	200	200	100	300	100	50	150	650

Questionnaires collected	85	65	150	162	66	228	83	23	106	484
Questionnaires deleted	9	7	16	17	9	26	8	3	11	53
Valid questionnaires	76	58	134	145	57	202	75	20	95	431
Response rate	85%	65%	75%	81%	66%	76%	83%	46%	80%	74%
Valid response rate	76%	58%	67%	73%	57%	67%	75%	40%	63%	66%

3.4.4 Statistical Analysis for Objective 2

3.4.4.1 Mean scoring technique

The mean score method has been widely adopted in the area of construction management and project management to establish the relative importance of various factors, such as the causes of delay in building projects in Hong Kong (Chan and Kumaraswamy, 1996), benefits of construction partnering practice (Chan et al., 2003), critical risk factors of public-private partnership projects in China (Xu et al., 2010), and hindrances to enterprise risk management implementation (Zhao et al., 2014). In this study, the mean scoring technique was applied to determine the rankings of the 36 safety communication factors in descending order of criticality, as perceived by EM construction workers, management staff, and local construction workers. The standard deviation was compared to determine the rank when two or more factors had the same mean scores. To identify the critical factors, the normalised values of the mean score were calculated, which were also applied in the studies of Xu et al. (2010) and Zhao et al. (2014). The factors with normalised values higher than 0.5 were deemed to be critical factors. The mean score for each factor was calculated using the following formula:

$$MS = \frac{\sum(f \times s)}{\mathrm{N}} \tag{5}$$

Where,

MS = mean score of a factor;

s = the score given to each factor by the respondents based on a five-point scale;

f = the frequency of responses to each rating;

N = the total number of responses on that factor.

3.4.4.2 Exploratory factor analysis

In order to achieve Objective 2, exploratory factor analysis (EFA) was conducted to identify the underlying constructs of the critical communication factors and indicators for safety performance of both EM construction workers and local workers. EFA has been extensively used to understand latent dimensions when researchers are unable to grasp ahead the number of underlying factors or the relation between factors and observed variables (Hair et al., 2006).

EFA requires the data to follow normal distribution and satisfy the sample adequacy. Thus, the suitability of the data was examined prior to factor extraction using Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (Kaiser, 1970) and Bartlett's test of sphericity (Bartlett, 1950). The KMO measure ranges from 0 to 1 (Hair et al., 2010a). The level of acceptance of KMO value varies with the value of KMO, as listed in Table 3.7. The significance value of Bartlett's test of sphericity lower than 0.05 was regarded as suitable to conduct factor analysis.

Table 3.7 Level of acceptance of KMO value

KMO value	Level of acceptance
0.90 or above	Marvellous
0.8 or above	Meritorious
0.7 or above	Middling
0.6 or above	Mediocre
0.5 or above	Miserable
below 0.5	Unacceptable

Note: This table is derived from the study by Field (2009).

There are several EFA extraction methods, such as principal components analysis, unweighted least squares, generalised least squares, maximum likelihood, principal axis factoring, alpha factoring, and image factoring (Williams et al., 2012). Among them, the most widely used by previous researchers is principal components analysis (PCA) (Thompson, 2004), probably because it is the default analysis in most statistical analysis software. PCA can enable the minimal loss of information and is especially recommended when no prior structure is established (Gorsuch, 1983).

To determine the number of constructs to be extracted, Kaiser's (1960) criterion, scree test (Cattell, 1966), Horn's (1965) parallel analysis, and the interpretability of the factors (Fabrigar and Wegener, 2011) were all taken into consideration. Kaiser's criterion, as a default factor retention method in SPSS, is to retain all factors with eigenvalues higher than 1 (Kaiser, 1960; Costello and Osborne, 2011). On the basis of examining the graph of eigenvalues and the break point of the curve, the scree test is used to retain the factors above the break point (Costello and Osborne, 2011). By constructing the random correlation metrics, parallel analysis retains the factors based on actual eigenvalues in the real data set that are greater than the parallel average random eigenvalues (Hayton et al., 2004). Kaiser's criterion and scree test might result in over-extraction of constructs to retain for rotation (Pallant, 2010), while Horn's parallel analysis is regarded as the most reliable approach to determine the number of constructs to retain (Hayton et al., 2004). The last, but most important consideration is the interpretability of the dimensions (Fabrigar and Wegener, 2011). In the case that the results of the number of factors produced by statistical methods conflict, the interpretability of factors will be the deciding criterion to determine the common factors, as suggested by Fabrigar and Wegener (2011). The interpretability criteria include: (1) at least three items with significant factor loadings (>0.30), (2) that items loading on one factor have conceptual meaning, (3) that items loading on different factors measure different constructs, and (4) that the rotated factor pattern has a simple structure (Suhr, 2006).

To aid in the interpretation of the factors, the rotation of data are usually conducted to obtain a simple structure, which means items have high loading on one factor and low loadings on other factors (Conway and Huffcutt, 2003; Suhr, 2006). The rotation methods can be categorised into two types: orthogonal rotations, suitable for factors that are uncorrelated, and oblique rotations, allowing factors that are correlated (Conway and Huffcutt, 2003; Williams et al., 2012). The recommendation for selecting the factor rotation method is that oblique rotation should be applied if factor correlations exceed 0.3 (Nunally and Bernstein, 1994) or 0.32 (Tabachnick and Fidell, 2001); otherwise, the orthogonal rotation approach should be selected. Since the SC factors and indicators of SP in this study were expected to be interrelated, the promax rotation approach, a widely used oblique rotation method, was applied and the correlations among factors were evaluated.

Once the factor matrix is generated, factor loadings need to be examined to identify and delete the items that have not loaded on any factor with significantly high factor loadings (Matsunaga, 2010). The criteria of how high the factor loading of item is being sufficient to retain in the item-screening procedure remains controversial. The cut-off point fall factor loading at 0.40 (i.e., items with factor loading under 0.4 were removed), has been deemed as the minimum threshold (Matsunaga, 2010), while 0.60 and 0.70 are the maximum threshold. In this study, the cut-off value was set at 0.60 to achieve a more significant result (Hair et al., 2010a). As the difference between the cross loadings should be at least 0.2 (Hair et al. 2010a), coefficients smaller than 0.3 were suppressed to simplify the factor matrix. Another criterion adopted to stop the extraction process was to achieve 60% of the cumulative variance (Oladinrin and Ho 2015). This also ensured that each extracted factor contained at least three items for achieving an acceptable reliability level (Seo et al. 2004; Zhou et al. 2011). Cronbach's alpha was computed to test the internal consistency and reliability of the extracted factors.

3.4.5 Statistical analysis for Objective 3

3.4.5.1 Structural equation modelling

In order to achieve Objective 3, structural equation modelling (SEM) was conducted to validate the constructs and test the aforementioned hypotheses and research model against the empirical data set. The SEM technique has been adopted by many researchers across disciplines. It combines factor analysis, multiple regression analysis, and path analysis to simultaneously examine the structure of the relationships among constructs (independent and dependent variables) depicted in equations (Ullman, 2006; Hair et al., 2010a). The independent and dependent variables can be either unobserved variables (latent variables) or observed variables (manifest variables or measured variables). Compared with the traditional correlation analysis method, SEM has four distinctive features in that it: (1) estimates multiple and interrelated dependence relationships, (2) represents unobserved concepts in these relationships, (3) considers measurement errors in estimation; and (4) defines a model explaining an entire set of relationships (Hair et al., 2006; Cho et al., 2009; Kline, 2016). Owing to these benefits, SEM has been used in an increasing number of studies in the field of construction management (Oke et al., 2012; Hon et al., 2014; Seo et al., 2015; Wu et al., 2015; Zahoor et al., 2017).

Sample size is one important consideration prior to conducting SEM. However, there is no agreement on the sample size most suitable for SEM in the literature (Wang and Wang, 2012). A minimum sample size of 100 is required to produce a reasonably reliable result for SEMs, as suggested by Bagozzi and Yi (2012) and Wang and Wang (2012), who also found that in terms of ratio of sample size to number of parameters, a satisfactory model can be achieved with ratios 3:1. In the context of construction management, Xiong et al. (2015) reviewed 84 articles that used the SEM technique and found that 77.4% of the articles were derived from sample sizes less than 200 and 85.7% of articles had a ratio of sample size to parameters of less than 5:1.

Various computer tools have been designed for SEM, such as Amos, EQS, LISREL, Mplus, and SAS (Xiong et al., 2015; Kline, 2016). These tools share similarities in the accuracy of the estimates produced for SEM. The major difference among them is in the user interface and the availability of different features (Narayanan, 2012). Amos can be used in both programming mode and graphical interface (Narayanan, 2012). In addition, it has advantages in excellent graphical interface and a well-organised and quickly accessible output format (Narayanan, 2012). Thus, Amos was applied to test and validate the hypothesised model in this study.

3.4.5.2 Evaluation of measurement model validity

Once the measurement model is specified, the sample size is sufficient, and the estimation method is determined, both reliability (item and construct) and validity (convergent and discriminant) should be assessed.

Reliability

Reliability measures the extent to which the indicators of one latent construct is internally consistent in their measurements (Hair et al., 2010b). Cronbach’s alpha reliability test, as the most common measure of reliability, was undertaken to measure internal consistency (Nunally and Bernstein, 1994; Shook et al., 2004). A Cronbach alpha coefficient above 0.70 is regarded as “sufficient” to conduct the study (Nunally and Bernstein, 1994). Cronbach’s alpha is based on the assumption that all items make an equal contribution to reliability (Shook et al., 2004), while composite reliability is more suitable, which is derived from the standardised loadings and the measurement error of each item.

In addition to the Cronbach's alpha, for assessing the internal consistency, inter-item as well as item-total correlation matrix were evaluated in the current study. Inter-item correlation examines the connections between items (Ferketich, 1990), and the proportion of item-item correlation coefficients ranging between 0.20 and 0.70 should be higher than 50% (Idvall et al., 2002). The item-total correlation examines the connections of one item to the total items (Robinson et al., 1991), and item-total correlation values should be higher than 0.30 (Nunnally, 1994).

Composite reliability (CR) tests the extent to which a set of observed variables actually reflects the latent construct (Hair et al., 2010b; Awang, 2012; Patel and Jha, 2016). The benchmark of CR is suggested as 0.7 by Nunnally (1994) and Hair et al. (2010b). CR can be calculated using below formula (6) (Hair et al., 2010b; Awang, 2012):

$$CR = \frac{\left(\sum_{i=1}^{n} L_i\right)^2}{\left(\sum_{i=1}^{n} L_i\right)^2 + \sum_{i=1}^{n} e_i} = \frac{\left(\sum_{i=1}^{n} L_i\right)^2}{\left(\sum_{i=1}^{n} L_i\right)^2 + \sum_{i=1}^{n} (1 - L_i^2)} \qquad (6)$$

Where,
L_i = standardised factor loading;
i = the i^{th} observed variables;
n = the number of observed variables;
e_i = the i^{th} error variance.

Validity

Validity is concerned with the extent to which a set of observed variables actually reflects the latent construct (e.g., convergent and discriminant) (Schumacker and Lomax, 2004; Hair et al., 2010b).

Convergent validity, which checks that items that load on one specific factor share a high percentage of variance in common, can be estimated in several ways, such as factor loadings and average variance extracted (AVE). The AVE is the mean of variance extracted for observed variable loading on a factor and can be calculated as follows:

$$AVE = \frac{\sum_{i=1}^{n} L_i^2}{\sum_{i=1}^{n} L_i^2 + \sum_{i=1}^{n} e_i} = \frac{\sum_{i=1}^{n} L_i^2}{\sum_{i=1}^{n} L_i^2 + \sum_{i=1}^{n} (1 - L_i^2)} \quad (7)$$

Where,
L_i = standardised factor loading;
i = the i^{th} observed variables;
n = the number of observed variables;
e_i = the i^{th} error variance.

To achieve a high convergent validity, the standardised loadings of items need to be higher than 0.50 (preferably 0.70), the threshold acceptable value of variance-extracted is 0.50, and the rule of thumb of AVE is no less than 0.50 (Hair et al., 2010b).

Discriminant validity is adopted for measuring the extent to which a factor differs from the other factors (Hair et al., 2010b). The Forneel-Lacker criterion is a widely used approach to test discriminant validity (Fornell and Larcker, 1981). According to this criterion, AVE of a particular construct should be higher than its squared factor correlation with other constructs (Fornell and Larcker, 1981; Xiong et al., 2015).

3.4.5.3 Evaluation of structural model validity

Goodness-of-fit indices, including preliminary fit criteria and overall model fit, help to evaluate whether the hypothesised model fits the empirical data (Bagozzi and Yi, 1988). The significance level is set as 0.01.

Preliminary fit criteria are suggested to be used to examine the existence of anomalies prior to evaluation of the overall criteria (Bagozzi and Yi, 1988). Four types of preliminary fit criteria need to be scrutinised: no negative error variances exist, no error variances are non-significant, no standardised factor loadings are smaller than 0.50 or greater than 0.95, and no standard errors are extremely large.

The overall goodness-of-fit is categorised into three types: absolute fit indices, incremental fit indices, and parsimonious fit indices. Three categories of overall goodness-of-fit criteria comprising of ten indices were adopted in this study to discuss the results of SEM, including:

- Absolute fit indices: root mean square error of approximation (RMSEA);

- Incremental fit indices: incremental fit index (IFI), Tucker-Lewis index (TLI), comparative fit index (CFI);
- Parsimonious fit indices: parsimony normed-fit index (PNFI), parsimony goodness-of-fit index (PGFI), parsimony comparative fit index (PCFI), and ratio between chi-square and degree of freedom (χ^2/df).

The indices commonly used and recommended by the researchers were applied to assess the model fit and the levels of acceptable fit for these measures are presented in Table 3.8 (Bagozzi and Yi, 1988; Hu and Bentler, 1995; Schermelleh-Engel et al., 2003; Hooper et al., 2008; Xiong et al., 2015; Patel and Jha, 2016).

Table 3.8 Overall goodness-of-fit of the structural equation model.

Goodness-of-fit Measures		Levels of Acceptable Fit	References
Absolute fit	RMSEA	< 0.8	Schermelleh-Engel et al., (2003); Xiong et al., (2015)
Incremental fit	IFI	> 0.9	Bagozzi and Yi, (1988); Hu and Bentler, (1995); Hooper et al., (2008); Xiong et al., (2015)
	TLI		
	CFI		
Parsimonious fit	PNFI	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PGFI	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PCFI	> 0.5	Xiong et al., (2015)
	χ^2/df	< 3.0	Patel and Jha (2016); Xiong et al., (2015)

3.4.5.4 Importance-explanation analysis

The importance-explanation analysis (IEA) was adapted from importance-performance analysis, which has been applied as an effective approach to identify product or service attributes that need to be enhanced by assessing the relative importance and performance (Matzler et al., 2004; Deng, 2008), as shown in Figure 3.3. The two dimensions of IEA refer to mean scores and standardised factor loading coefficients of SC factors. This method was used by Chou et al. (2012) to evaluate the critical factors for public-private partnership policy, and Chou and Pramudawardhani (2015) to evaluate the key barriers and critical success factors for public-private partnership projects.

The mean scoring technique is suitable for evaluating the relative importance of SC factors but is unable to assess the covariance in the variables. Mean scoring assumes that each item is independent and has no connection with other items (Chou and Pramudawardhani, 2015). The factor loadings derived from SEM can measure the explanatory power of items, which can remedy this defect of mean scoring. The IEA combines the mean scoring and factor loading with the mean scoring method evaluating relative importance and factor loading evaluating the explanatory power.

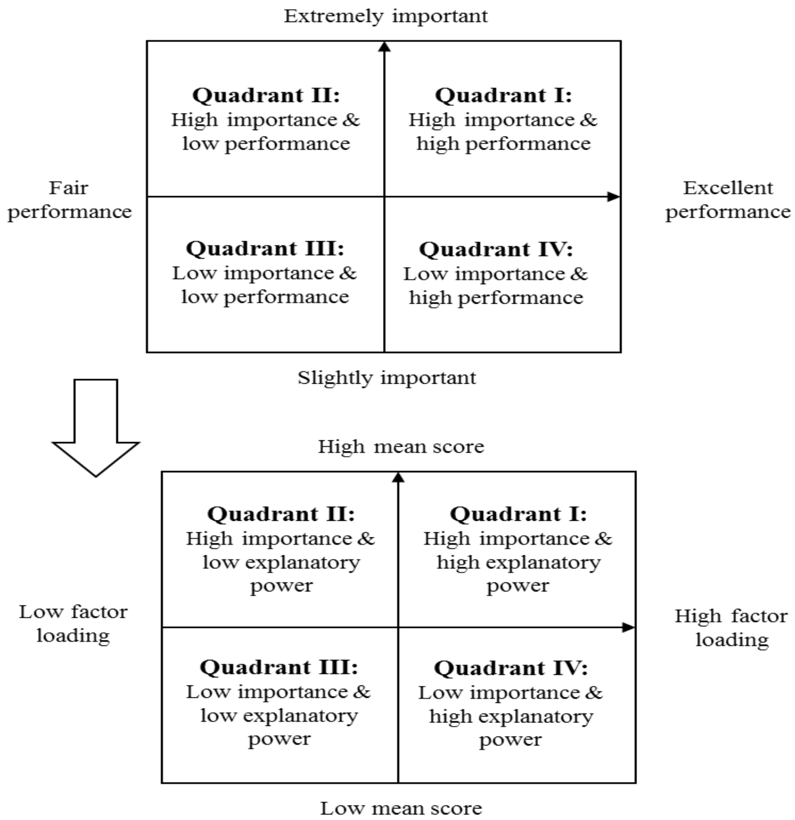

Figure 3.3 Importance-explanation analysis

Note: This figure is adapted from Chou et al. (2012)

The IEA method visually depicts the relative importance of both the perceived mean score as *Y*-axis and explanatory power of each item as *X*-axis. The factors with both mean values and factor loadings higher than the average are located in the first quadrant (Quadrant I) and regarded to have higher importance and higher explanatory power compared with other factors. The items with lower-than-average mean scores and factor loading coefficients fall into the fourth quadrant (Quadrant IV) and are regarded as being of relatively low importance and explanatory power.

3.4.6 Statistical analysis for Objective 4

3.4.6.1 Kendall's coefficient of concordance W

Kendall's W was used to test the agreement within each group of management staff regarding the SC factors of EMs. The details of Kendall's W were described in Section 3.3.3. The null hypothesis H_0 is "There is no significant agreement among respondents in the rankings of different SC factors of EMs within each group", and the alternative hypothesis H_1 is "There is significant agreement among respondents in the rankings of different SC factors of EMs within each group".

3.4.6.2 Spearman rank-order correlation analysis

The level of association between two groups of management on their ranking of SC factors of EMs was assessed using the Spearman's correlation. The details of Spearman's correlation were described in Section 3.3.4. The null hypothesis H_0 that "there is no significant relationship between two groups on the rankings of SC factors of EMs" was tested against the alternative hypothesis H_1 that "there is significant relationships between two groups on the rankings of SC factors of EMs."

3.4.6.3 Independent-samples t-test

The independent-samples *t*-test is a parametric method for comparing means from two independent groups to assess whether there is a significant difference in the associated population means (Heiman, 2013). In the current study, independent *t*-test was applied to assess:

1) Whether there was a significant difference in the mean scores of SC factors of EMs between the EM group and management group. The null hypothesis (H_0) and alternative hypothesis (H_1) of independent *t*-test were: H_0: $\mu_{EMs} = \mu_{Management}$, the means of SC factors of EMs from two population are equal; H_1: $\mu_{EMs} \neq \mu_{Management}$, the means of SC factors of EMs from two population are not equal. The μ_{EMs} and $\mu_{Management}$ refer to the mean scores of EMs groups and management staff group, respectively.

2) Whether there was a significant difference in mean scores of SC factors between EM group and local worker group. The null hypothesis (H_0) and alternative hypothesis (H_1) were: H_0: $\mu_{EMs} = \mu_{Local}$, the means of SC factors

from two population are equal; H_1: $\mu_{EMs} \neq \mu_{Local}$, the means of SC factors from two population are not equal. The μ_{EMs} and μ_{Local} refer to the mean scores of EMs groups and local worker group, respectively.

3.5 RESEARCH STRATEGIES FOR OBJECTIVE 5, 6, 7

3.5.1 Design of questionnaire for survey 2

The questionnaire for survey 2 was designed to collect the personal attributes, predominant safety communication structure, and perceptions of safety climate of EMs (see Appendix F). This questionnaire instrument consisted of three sections.

- In Section A, respondents' demographic information and data were collected, including age, trade, educational level, number of years of construction industry experience, language proficiency, safety training, communication tools, number of accidents experienced in the past six months, and so forth.
- Section B solicited data related to safety communication flow, which was adapted from the questionnaire in the study of Alsamadani et al. (2013b). A questionnaire is the most commonly used instrument to collect quantitative interactional sociometric network data (Scott, 2012). In the first part, the respondents were asked to list the names of individuals from whom they received safety information frequently and the language they used for safety communication. In the second part, they were asked to list the names of individuals to whom they provide safety information frequently and the language they used for safety communication.
- Section C comprised of 38 questions about safety climate. The Safety Climate Index (SCI) developed by the Occupational Safety and Health Council in Hong Kong was used because it was specifically designed and developed in the context of the Hong Kong construction industry (Occupational Safety and Health Council 2008). Furthermore, the SCI was also used by Hon et al. (2012; 2014) and Chan et al. (2017b) to effectively determine the safety performance of construction workers in Hong Kong.

3.5.2 Data collection of questionnaire survey 2

Background investigation and interviews with professionals were conducted to determine the criteria for case selection in questionnaire survey 2. This was to ensure that EM crews selected for cases studies are representative of EM crews in the Hong Kong construction industry. A lists of four criteria was identified from the background investigation and interviews for selecting EM crews, including (1) consisting of frontline EM construction works and frontline level management; (2) including Nepalese and Pakistani employees because they made up the largest proportion of EMs in the Hong Kong construction industry (Census and Statistics Department 2013, p. 69); (3) having worked together for over six months at the same construction site; (4) having the same task and employer. The questionnaires were translated into Nepali and Urdu for Nepalese and Pakistani participants who were not fluent in English by professional translation company. The translated questionnaires were reviewed by researchers who are native speakers and obtained the PhD degree in construction management to ensure the accuracy of translations. The researchers contacted and invited most of the leading construction companies in Hong Kong about the targeted EM crews. A total of nine EM crews at different construction sites were initially selected for data collection. The details of data collection procedures were discussed with the managerial and supervisory staff of these projects prior to site visits. All participants could list as many individuals as they preferred, because this unlimited nomination approach is more valid when workers tend to have a different number of nominations (Terry, 2000).

In order to reduce response bias, management were not present during each data collection session onsite and some PhD students who can speak EM native languages were trained to assist the questionnaire survey and explain the questions to EMs onsite. The background and purpose of this questionnaire survey was firstly explained to all participants. They were also informed that confidentiality would be protected throughout the research, and the data collected would only be used for academic purposes. All participants were provided with questionnaires in Cantonese, English, and their native language (i.e., Urdu and Nepali) for their selection. The questionnaire survey took 40 to 50 minutes to complete. Once completed, the questionnaires were collected directly by the researchers.

A total of nine EM crews were initially involved in the data collection at different construction sites. As SNA technique requires a high response rate (i.e., 80%) (Wasserman and Faust 1994), three EM crews with low response rate were excluded. Table 3.9 shows the composition of the remaining six crews. A total of 82 participants were involved, including 21 frontline level managers and 61 frontline workers, who were all employed by sub-contractors. Workers were all EMWs, except for Crew 4, which contained two local workers. In terms of the nationality of EMWs, four crews were composed of Nepalese and two crews were composed of Pakistanis. The size of crews ranged from 10 to 21. The number of workers for each crew ranged from seven to 14, while the number of managers for each crew ranged from two to seven.

Table 3.9 Composition of the crews participated in this study

Crew No.	Crew size	Composition of crews				Length of working together
		Management staff	Local workers	Nepalese workers	Pakistani workers	
1	11	3	-	8	-	6 months
2	10	3	-	7	-	7 months
3	21	7	-	14	-	6 months
4	12	2	2	-	8	7 months
5	16	2	-	14	-	6 months
6	12	4	-	-	8	8 months
Total	82	21	2	43	16	

3.5.3 Statistical analysis

3.5.3.1 Social Network Analysis

Social network analysis (SNA) is used to analyse the structure of relations or interactions between social entities in many fields, such as social and behavioural sciences. A social network is a collection of actors (nodes) and the relational ties among them (Scott and Carrington, 2011). According to the nature of relations, networks can be categorised as directed (non-symmetric) and undirected (symmetric) (Yang et al., 2016). SNA can examine the attributes of actors and also quantify and visualise the relationships among these actors. In the construction domain, social network theory and analysis have been increasingly applied to investigate a variety of research topics, such as risk management, knowledge management, communication, innovation diffusion, and resource management (Zheng et al., 2016). The majority of previous studies on communication networks focused on organisational-level networks; that is, identifying the relationships between or among organisations or firms (Chinowsky et al., 2009). Currently, this focus has been expanded to include small group or crew networks (where all members are distinct individuals and tend to know each other), such as the studies of Alsamadani et al. (2013a), and Allison and Kaminsky (2017). In the present study, the sociogram of each EM crew was produced with the help of the software Netdraw. A sociogram is the picture in which actors are presented as points and the relationships among pairs of people are represented by lines linking the corresponding pints (Wasserman and Faust, 1994). Two levels of social network analysis were conducted: (1) network level analysis (i.e., network density and reciprocity), and (2) actor level analysis (i.e., degree centrality, closeness centrality and betweenness centrality) (Borgatti et al., 2002), as summarised in Table 3.10. A combined use of these distinct measures offers a richer view of network topology than any measure does alone.

Table 3.10 SNA measures adopted in the study

Network Density		The number of connections contained within the network.
Reciprocity	Dyadic reciprocity	The proportion of reciprocated dyads among all adjacent dyads.
	Arc reciprocity	The proportion of reciprocated arcs among all arcs.
Centrality	Degree centrality	In-degree: The extent to which an actor is a receiver of information from other actors. Out-degree: The extent to which an actor is a provider of information to other actors.
	Closeness centrality	In-closeness: The distance to be contacted by other actors. Out-closeness: The distance to contact all other actors.
	Betweenness centrality	The extent to which an actor functions as a 'gatekeeper' in information flow, by occupying a controlling and intermediary position on the geodesic between other pairs of members.

The density of the safety communication network is a property of the overall level of connections. Density is defined as the ratio of the number of ties present in the network to the maximum possible number of ties (Hanneman and Riddle, 2005), and varies from 0 to 1. A score approaching 1 indicates a denser network, whereas a score approaching 0 indicates a sparse network. For a directed network, the network density (Δ) can be calculated using the following formula:

$$\Delta = \frac{l}{n(n-1)} \tag{8}$$

Where,

n = the number of nodes;

l = the number of ties present.

Reciprocity shows the extent to which the actor has reciprocated or returned ties to another actor. There are different methods to measure reciprocity, such as dyad based and arc based (Hanneman and Riddle, 2005). Dyad reciprocity is most commonly reported and is calculated by dividing reciprocated dyads by all adjacent dyads. Arc reciprocity is less commonly reported and is calculated as the proportion of reciprocated arcs among all arcs. The score of reciprocity ranges from 0 (no ties are reciprocated) to 1 (all ties are reciprocated). Networks with a great deal of reciprocity are often more balanced, stable, and harmonious.

Centrality is an indicator of a member's position in a crew, measuring how central an actor is in a network. A member with a more central position has more opportunities to have social contacts. Centrality can be categorised into three main types, namely degree centrality, closeness centrality, and betweenness centrality (Hanneman and Riddle, 2005). Degree centrality measures the degree to which an actor is directly connected to other actors (Freeman, 1978). In a directed network, degree centrality is categorised as out-degree centrality and in-degree centrality. Out-degree and in-degree centrality represent the extent to which an actor is a provider or receiver of information to or from other actors. Closeness centrality denotes how closely a crew member is connected to other members, and how accessible other members' support is. In a directed network, in-closeness and out-closeness can both be measured. In-closeness reveals the distance to be contacted by other members, whereas out-closeness shows the distance to contact other members. Betweenness centrality in communication network measures the degree to which a member functions as a "gatekeeper" in information flow, by occupying a controlling and intermediary position on the geodesic (i.e., the shortest path) between other pairs of members (Scott and Carrington, 2011). Normalised degree centrality, closeness centrality, and betweenness centrality scores are used for comparisons among participants from crews with different sizes (Hanneman and Riddle, 2005). Normalised centrality values vary between 0 and 1, with a score towards 1 representing that an actor occupies a very central position in a safety communication network.

3.5.3.2 Mann-Whitney U test

The Mann-Whitney *U* test assesses whether there is difference between two independent groups on a single and ordinal variable with no specific distribution (Mann and Whitney, 1947). Contrary to a *t*-test, which assumes a normal distribution, a Mann-Whitney *U* test assumes no specific distribution. It is more suitable when the data are non-normal. If the *p*-value in the Mann-Whitney *U* test is greater than 0.05, a significant difference exists in the median values between two groups (Sheskin, 2003). The Mann-Whitney *U* statistic can be calculated using the following formula:

$$U = n_1 n_2 + \frac{n_2(n_2+1)}{2} - \sum_{i=n_1+1}^{n_2} R_i \qquad (9)$$

Where,
U = Mann-Whitney *U* test;
n_1 = Sample size one;
n_2= Sample size two;
R_i = Rank of the sample size.

In this study, the Mann-Whitney *U* test was applied to determine if a significant difference exists in centrality in safety communication networks as a result of the personal attributes of EMWs.

3.5.3.3 Kruskal-Wallis H test

The Kruskal-Wallis *H* test was applied to examine if a significant difference exists among different groups. It is a rank-based nonparametric. The Mann-Whitney *U* test is suggested for populations with two groups, whereas the Kruskal-Wallis *H* test is suitable for the sample with over two groups (Field, 2009). If the Kruskal-Wallis *H* statistics is significant, there is significant difference among the samples. The *H* statistics can be computed using the below formula (Ghasemi and Zahediasl, 2012, p 59):

$$H = \frac{12}{\mathrm{n(n+1)}} \sum_{i=1}^{k} \frac{R_i^2}{n_i} - 3(n+1) \qquad (10)$$

Where,
n = the number of values from all combined samples;

R_i= the sum of the ranks from a particular sample;

n_i = the number of values from the corresponding rank sum.

3.6 CHAPTER SUMMARY

In order to achieve the research objectives, both qualitative and quantitative research methods were considered and selected, including a literature review, semi-structured interviews, a Delphi survey, and questionnaire survey. Various data analysis methods were used to analyse the data collected from questionnaires, such as descriptive statistics, Kendall's coefficient of concordance, Spearman rank-order correlation analysis, *t*-test, factor analysis, structural equation modelling, social network analysis, Mann-Whitney *U* test, and Kruskal-Wallis *H* test.

Chapter 4: Safety and Health Problems of EMs[4]

4.1 INTRODUCTION

This chapter presents the findings from the face-to-face semi-structured interviews and two-round Delphi surveys to fulfil Objective 1, to identify and evaluate the relative severity of the safety and health related problems experienced by EM construction workers.

4.2 SAFETY AND HEALTH PROBLEMS CATEGORIES OF EMS

As shown in Table 4.1, 14 subcategories and four major categories of safety and health problems of EM construction workers were initially identified based on constant comparative analysis method.

[4] Published in Chan, A.P.C., Wong, F.K.W., Hon, C.K.H., Javed, A.A., Lyu, S.*, 2017. Construction safety and health problems of ethnic minority workers in Hong Kong. Engineering, *Construction and Architectural Management*, 24, 901-919.

Table 4.1 Categories and subcategories of safety and health problems of EMs

Categories	Subcategories
C1. Insufficient organisational interventions/strategies to support EMWs	S1. Lack of safety culture and management commitment for EMWs
	S2. Lack of opportunities for EMWs' recruitment and career development
	S3. EMWs are assigned more laborious and unsafe work
	S4. Racial discrimination against EMWs
	S5. Neglect of cultural and religious backgrounds
	S6. Insufficient safety training for EMWs in their native languages
	S7. Insufficient safety materials in EM native languages
	S8. Insufficient safety staff of EM origin
C2. Insufficient government support for EMWs	S9. Absence of separate government budget and subsidy for safety management of EMWs
	S10. Lack of government support to enhance EMWs' safety performance
C3. Language and communication barriers of EMWs	S11. Safety communication problems
	S12. Personal characteristics of EMWs influence their safety performance
C4. Low skill level and safety awareness of EMWs	S13. Low safety and health awareness and knowledge of EMWs
	S14. Low skill level of EMWs

4.2.1 Category 1: Insufficient organisational interventions/strategies to support EMs

S1. Lack of safety culture and management commitment for EMWs.

The interviews revealed that there was a lack of safety culture and management commitment towards EMWs. For instance, the safety management was unable to understand the characteristics of EM workers, safety promotion program is not suitable for them, and there is unfair welfare. As stated by interview E, more patience and active listening are required in dealing with the concerns and grievances from EMWs because they are afraid of losing their jobs compared with the local counterparts.

S2. Lack of opportunities for EMWs' recruitment and career development.

The job opportunities of EMWs were only limited to some common trades which local workers are reluctant to work in, such as steel bar bending and fixing, metal form working, and metal scaffolding. Furthermore, the job promotion was difficult for EMWs, as stated by interviewee D. However, if EMWs have more opportunities of employment and career development, they will be more likely to be motivated to behave safely. As highlighted by interviewee F, a career path is required for EMWs, i.e., worker → ganger → foreman → safety supervisor or officer, and if an increasing number of companies provide a career development to EMWs, they can better fit in the construction industry and the society.

S3. EMWs are assigned more laborious and unsafe work.

Most interviewees stated that more laborious and risky work are assigned to EMWs than local workers, such as moving concrete and cement, and cleaning construction debris. Interview M pointed out the main reason is that local workers are reluctant to do these jobs and foremen had to assign these jobs to EMWs as EMWS are considered as physically stronger. However, EMWs generally have a less knowledge of safe work procedures and precautions than their local counterparts, thus they tend to be vulnerable to accidents and injuries. Interviewee P highlighted that EMWs often suffer from acute and chronic lumbar muscle strain.

S4. Racial discrimination against EMWs.

As pointed out by interviewees, EMWs are more likely to be subjected to both indirect and direct discrimination. Direct discrimination faced by EMWs was reflected in the different treatment of EMWs and local workers. For instance, interviewee B mentioned that EMWs in Hong Kong were usually paid approximately 10% less than local workers. The sense of unfair treatment makes EMWs frustrated and demotivated, especially in the case that they carry out more laborious work. In addition, the indirect discrimination faced by EMWs mainly indicates some regulations and rules of the employer that seem like fair are unfavourable to EMWs.

S5. Neglect of cultural and religious differences.

The different cultural and religious backgrounds of EMWs have not received enough attention from some safety staff, as expressed by ten interviewees. Interviewee J mentioned that a multicultural and multinational workplace would result in a relatively high level of tension and stress among workers. Furthermore, homesickness, frustration, and pressure of EMWs, derived from the difficulties of fitting in the new and different work environment and local society, have a negative effect on the safety and health of EMWs. Furthermore, safety management need to take the religious practice of EMWs into consideration. Interviewee E and H pointed out safety management should be aware of two points regarding Muslims employees: “They need to worship five times a day, and two to three times would clash with their work” and “Fasting during Ramadan might affect their physical conditions to cope with the demand of the work.”

S6. Insufficient safety training for EMWs in their native languages.

The interviewees (N = 13) revealed that the languages of most safety trainings (e.g., morning briefing, induction, and toolbox talk) was Cantonese or English. The large construction companies and public developers which employed numerous EM construction workers have translated safety trainings to EM native languages. The other employers normally trained the EM construction workers in the same ways of training local employee. EM construction workers may not fully interpret what they need to grasp in the safety trainings because of their relative low level of language ability. As stated by interviewee A, EMWs who were trained in Cantonese or English did not fully understand the content. In addition to this, interviewee L revealed that although EMWs could not fully interpret the safety training, they still said they had fully understood. Interviewee N also highlighted that “knowing their level of understanding of safety training is difficult because they are very self-protective.”

S7. Insufficient safety materials in EM native languages.

The majority of interviewees (N = 13) pointed out that the safety materials in their companies or organizations were prepared in either Cantonese or English. However, none of interviewees mentioned that safety materials were translated into EM native languages. Considering that the translation of safety materials required extra investment, many contractors, especially for small subcontractors, are reluctant to provide safety materials in EM native languages. In addition, interviewee Q highlighted that although several large construction companies have translated some safety materials into their languages, it is hard to ensure accuracy of translation due to a lack of professional translator.

S8. Insufficient safety staff of EM origin.

The interviewees expressed that there were very few and insufficient safety staff from EM origin. The employment of EM safety staff can bring many benefits. For instance, the communication between EM staff and EMWs is more effective. The information delivered from safety management team to EMWs was not well received by EMWs. As interviewee B expressed, only 70% of the information passing from safety management team was obtained by EMWs. Most interviewees highlighted the significance and necessity of employing EM safety staff. Suggestions have been provided by interviewee R and B that “identify and train the safety officer in charge of EM group and increase the supply of EM safety trainers”, and “to employ a full-time EM supervisor for a large number of EMWs.”

4.2.2 Category 2: Insufficient government support for EMs

S9. Absence of a separate government budget and subsidy for safety management of EMWs.

Currently, the government has not allocated a separate budget and subsidy towards the safety management of EMWs. As stated by interviewee R and L, no budge has been allotted by the government for their safety and some large construction companies had to pay for incentive scheme out of their pocket for improving EMWs’ safety performance due to lack of government subsidy.

S10. Lack of government support to enhance EMWs’ safety performance.

There is a lack of government support for improving safety performance of EMWs. As stated by interviewee F, the resources regarding safety provided by the government were rather limited. For instance, EMWs usually need to wait over two months to attend the relevant safety training and they may be injured in this period. The government can offer some free language course and face-to-face talks to EMWs. Although some safety materials (e.g., pamphlets, brochures, and posters) have been made by the government organizations, such as Occupational Safety and Health Council and Labour Department, these materials are not well disseminated to EMWs. The dissemination channels mainly rely on Chinese TV, Internet, and local newspapers and are not suitable for EMWs to access.

4.2.3 Category 3: Communication barriers of EMWs

S11. Safety communication problems.

Safety communication barrier is regarded as one of the major problems for EMWs by the majority of interviewees. Most EMWs can only speak simple predominant languages used onsite (i.e., Cantonese and English) and are unable to fully understand professional terminology and instructions from their supervisors and safety officers. They also have difficulties in expressing their concerns and communication with local workers. A fatal accident was cited by interviewee C that “When local workers spoke Cantonese and tried to use gestures to stop one EM worker from entering a crane operation zone, the EM worker misunderstood and was struck by the materials being transported”.

S12. Personal characteristics of EMWs influence their safety performance.

Interviewees ($N = 9$) have pointed out some specific personal characteristics, including having low self-confidence, obedience, diligence, strong ethnic ties, reliability, and be afraid of losing jobs. Some personal characteristics of EMWs have a negative influence on their safety performance. For example, interviewee D revealed that that “Nepalese and Indian workers tend to be extremely loyal to their employers and will do whatever the foreman asks them to do, no matter how safe or unsafe the task is.” In addition, “some EMWs are very reserved and afraid of speaking out because they believe that their managers or co-workers may think that they have limited knowledge”, as stated by interviewee L. Interview N also mentioned that EM construction workers were slightly more reactive, silent, and seldom complained. These characteristics may hinder EMWs from speaking out or rejecting some risky tasks, which may put them in danger.

4.2.4 Category 4: Low skill level and safety awareness of EMs

S13. Low safety and health awareness and knowledge of EMWs.

Four interviewees (i.e., interviewees E, F, M and N) mentioned that EMWs normally have a relative low level of safety awareness and knowledge. As stated by interviewee M, many EMWs moved from the countries having relatively low safety and health standards, and thus they may lack safety knowledge and are more likely to carry out their tasks in their own way. This may be normal in their origin country but is not safe in Hong Kong. Interviewee W has illustrated one fatal accident of EMWs, “One

Nepalese worker fell over 20 meters from the edge of a bridge as he tried to conduct the work in his own way without following the instructions of his supervisor."

S14. Low skill level of EMWs.

The interviewees regarded that the skill level of EMWs was relatively low compared with local workers. Many EMWs had no work experience in the construction industry before they came to Hong Kong. Thus, they lack some basic knowledge in safely using the machines, tools, and facilities. Although some EMWs may had worked in the construction in their home country, the skills, tools and materials used there may differ from those applied in local construction industry. As mentioned by interviewees C, E, and N, most EMWs can only work as manual labourers (e.g., manual handing, soil excavation, and loading of materials). Interviewee C also mentioned that "In general, they are not involved in highly skilled trades; thus, the greatest challenge is how to improve the skill level of EMWs."

4.3 RELATIVE SEVERITY OF THE IDENTIFIED PROBLEMS

After 14 subcategories of safety and health problems faced by EMWs were identified from interviews by constant comparative analysis, two rounds of Delphi survey were conducted to evaluate these safety and health problems. In the first round of Delphi survey, a Delphi questionnaire was firstly designed based on the results of interviews, as shown in Appendix D. A presentation lasting nearly one hour was made to expert panel to introduce the purpose of the study, the process of identifying the safety and health problems, and explain each problem. After the presentation, all experts were requested to evaluate the relative severity of safety and health problems in the Delphi questionnaire. The completed questionnaires were collected and analysed using SPSS software (Norušis, 2012). As show in Table 4.2, the four most severe safety and health problems in the first round were: "Insufficient safety materials in EM native languages", "Safety communication problems", "Insufficient safety training for EMWs in their native languages", and "Absence of separate government budget and subsidy for safety management of EMWs."

In the second round of Delphi survey, the results of first round and the Delphi questionnaire were distributed to all experts again to re-evaluate the safety and health problems taking into consideration of the results of the first round. In this round, most Delphi experts changed their ratings in the first round. The four most severe safety and health problems were “Insufficient safety materials in EM native languages”, “Insufficient safety training for EMWs in their native languages”, “Insufficient safety staff of EM origin”, and “Safety communication problems.”

Spearman’s correlation test was carried out to analyse the rankings of two rounds of Delphi survey. The results show that the Spearman’s correlation coefficient of the rankings of two rounds was 0.460 with $p = 0.042 < 0.05$. It indicates that the rankings of two rounds were strongly correlated at a 0.05 significance level.

A non-parametric statistical marginal homogeneity test was used to assess the difference of rankings in each safety and health problem in two rounds of survey. The results show that two statements “Absence of separate government budget and subsidy for safety management of EMWs” and “EMWs are assigned more laborious and unsafe work” had two-sided p-values less than 0.05 (see Table 4.2). It indicates that there was significant difference in the rankings of these two safety and health problems in the first and second round of Delphi survey. In the second round, the experts reduced the rankings of these two problems in the second round.

In addition, the chi-square χ^2 was calculated in order to assess the degree of consistency of experts in each round. As shown in the Table 4.2, the chi-square χ^2 in the first round was 27.006 ($df = 13$, $N = 18$) with $p < 0.05$, which was higher than the critical chi-square values $x^2_{0.05} = 25.49$ and smaller than $x^2_{0.01} = 35.08$. It indicates that the null hypothesis was rejected at 0.05 level and supported at 0.01 level. In the second round, the chi-square χ^2 increased significantly to 47.340 ($df = 13$, $N = 18$) with $p < 0.01$, which was higher than the critical values. Thus, a significant degree of consistency among all Delphi experts regarding the rankings of safety and health problems was achieved at both 0.05 and 0.01 levels in the second round.

Table 4.2 Two-round Delphi survey results

Categories	Round One		Round Two		Marginal Homogeneity Test	
	Mean	Rank	Mean	Rank	Std. MH Statistic	*p*
C1. Insufficient organizational interventions/strategies to support EMWs						
S1. Lack of safety culture and management commitment for EMWs	3.72	6	3.44	6	0.962	0.336
S2. Lack of opportunities for EMWs' recruitment and career development	3.56	9	3.22	11	1.5	0.134
S3. EMWs are assigned more laborious and unsafe work	3.78	5	2.67	13	2.774	0.006
S4. Racial discrimination against EMWs	3.00	14	2.56	14	1.414	0.157
S5. Neglect of cultural and religious differences	3.72	6	3.39	7	1.177	0.239
S6. Insufficient safety trainings for EMWs in their native languages	4.00	**3**	3.89	**2**	0.408	0.683
S7. Insufficient safety materials in EM native languages	4.11	**1**	4.06	**1**	0.2	0.841
S8. Insufficient safety staff of EM origin	3.56	9	3.72	**3**	-0.539	0.590
C2. Insufficient government support for EMWs						
S9. Absence of separate government budget and subsidy for safety management of EMWs	4.00	**3**	3.06	12	2.38	0.017
S10. Lack of government support to enhance EMWs' safety performance	3.67	8	3.56	5	0.408	0.683

C3. Language and communication barriers of EMWs						
S11. Safety communication problems	4.06	**2**	3.67	**4**	1.219	0.223
S12. Personal characteristics of EMWs influence their safety performance	3.56	9	3.39	7	0.6	0.549
C4. Low skill level and safety awareness of EMWs						
S13. Low safety and health awareness and knowledge of EMWs	3.33	12	3.39	7	-0.243	0.808
S14. Low skill level of EMWs	3.33	10	3.22	10	0.707	0.480
Number (n)	18		18			
Chi-square (x^2)	27.006		47.340			
Degree of freedom (df)	13		13			
Level of significance (p)	0.012		0.000			

Note: Two-tailed test.

4.4 CHAPTER SUMMARY

This chapter presented the data analysis results and research findings of Object 1 "Identify and rank according to severity the safety and health related problems experienced by EM construction workers". Based on 18 semi-structured interviews with professionals in the Hong Kong construction industry, a total of 14 subcategories and four main categories of construction safety and health problems of EMWs were identified. A two-round Delphi survey of 18 experts, who were highly experienced in managing EMWs was conducted to rank the relative severity of the identified safety and health problems. Among the 14 subcategories, the most urgent and serious problems were "Insufficient safety materials and training in their native language", "Insufficient safety staff from EM origin", and "Safety communication barriers". In addition, safety and health problems at the corporate and governmental levels are also worthy of attention.

Chapter 5: Identifying Critical Safety Communication Factors and Their Effects on the Safety Performance of EMs

5.1 INTRODUCTION

This chapter presents the research findings of Objectives 2 and 3. The critical safety communication factors for EMs are identified. The relationships between critical safety communication factors and the safety performance of EMs are also established.

5.2 DESCRIPTIVE STATISTICS OF EMS

A total of 200 questionnaires were distributed to EMs, including 100 in Hong Kong and 100 in Australia. The number of questionnaires collected from EMs in Hong Kong and Australia was 85 and 65, respectively, and the response rate was 85% and 65%, respectively. Due to outliers, numerous missing data, and a high percentage of repeated data, nine questionnaires from Hong Kong and seven questionnaires from Australia were deleted. A total of 76 and 58 valid questionnaires remained and the valid response rate was 76% and 58% for EM respondents in Hong Kong and Australia. Of the 76 EM respondents in Hong Kong, nearly 38.2% (N = 29) were Nepalese, 28.9% (N = 22) were Pakistani, 7.9% (N = 6) were Korean, and 25.0% (N = 19) were African. Among 58 EM respondents in Australia, 65.5% (N = 38) were from South Korea and 34.5% (N = 20) were from China. Their trades include labourers, plumbers, scaffolders, carpenters, concreters, and equipment operators. Table 5.1 lists the demographic information of the EM respondents, including age, employer, education level, work experience in the construction sector, and length of service with the current company.

Table 5.1 Demographic information of EMs

Demographic variables		Number	Percentage
Age	20 or below	2	1.5
	21 – 30	32	23.9
	31 – 40	67	50.0
	41 – 50	30	22.4
	51 or above	3	2.2
Education level	Below primary	2	1.5
	Primary	8	6.0
	Secondary	58	43.3
	Certificate	46	34.3
	Degree or higher	20	14.9
Employer	Contractor	33	24.6
	Subcontractor	101	75.4
Work experience in the construction industry	< 1 years	24	17.9
	1 – 5 years	53	39.6
	6 – 10 years	38	28.4
	11 – 15 years	12	9.0
	> 15 years	7	5.2
Length of service with the current company	< 1 year	34	25.4
	1 – 5 years	34	25.4
	6 – 10 years	11	8.2
	> 10 years	55	41.0

5.3 IDENTIFYING THE CRITICAL SC FACTORS OF EMS

As shown in Table 5.2, the mean scores of safety communication factors of EMs ranged from 3.38 to 4.13. In order to select the critical safety communication factors, the normalised values of the mean scores were calculated. This approach was employed by Xu et al. (2010) where normalised values equal or larger than 0.50 were critical factors. In this study, normalised values were used to determine the critical safety communication factors of EMs. As shown in Table 5.2, there were a total of 18 factors with normalised values greater than 0.50. This indicated that EMs perceived that those 18 factors were critical factors influencing their effectiveness of safety communication. The top three critical factors were "Adequacy of language ability of workers" (D5), "Personality characteristics of workers" (D6), and "Adequacy of workers' work experience in construction" (D4). The three least important factors were

"Adequacy and appropriateness of formal presentation from upper management" (D29), "Appropriateness of physical environment" (D36), and "No drinking habits of workers" (D8).

Table 5.2 Rankings of safety communication factors of EMs

Code	Number of respondents scoring					Mean	Normalised value	Rank
	1	2	3	4	5			
D5	**0**	**2**	**33**	**45**	**54**	**4.13**	**1.00**	**1**
D6	**0**	**10**	**24**	**46**	**54**	**4.07**	**0.93**	**2**
D4	**0**	**4**	**31**	**51**	**48**	**4.07**	**0.92**	**3**
D21	**1**	**3**	**29**	**57**	**44**	**4.04**	**0.89**	**4**
D24	**0**	**4**	**36**	**52**	**42**	**3.99**	**0.81**	**5**
D10	**0**	**7**	**35**	**45**	**47**	**3.99**	**0.81**	**6**
D1	**0**	**4**	**37**	**51**	**42**	**3.98**	**0.80**	**7**
D34	**2**	**10**	**31**	**38**	**53**	**3.97**	**0.79**	**8**
D9	**0**	**2**	**40**	**53**	**39**	**3.96**	**0.78**	**9**
D22	**0**	**1**	**40**	**58**	**35**	**3.95**	**0.76**	**10**
D33	**6**	**7**	**30**	**38**	**53**	**3.93**	**0.74**	**11**
D23	**0**	**2**	**44**	**50**	**38**	**3.93**	**0.73**	**12**
D13	**0**	**6**	**37**	**53**	**38**	**3.92**	**0.72**	**13**
D27	**2**	**7**	**39**	**39**	**47**	**3.91**	**0.71**	**14**
D17	**0**	**9**	**28**	**64**	**33**	**3.90**	**0.70**	**15**
D12	**0**	**7**	**32**	**63**	**32**	**3.90**	**0.69**	**16**
D31	**5**	**2**	**40**	**45**	**42**	**3.87**	**0.66**	**17**
D26	**0**	**10**	**49**	**33**	**42**	**3.80**	**0.56**	**18**
D7	5	13	42	32	42	3.69	0.42	19
D35	7	6	50	30	41	3.69	0.41	20
D2	10	12	29	48	35	3.64	0.35	21
D28	6	12	42	40	34	3.63	0.33	22
D16	10	12	37	35	40	3.62	0.32	23
D18	17	5	34	39	39	3.58	0.27	24
D20	7	12	47	33	35	3.57	0.26	25
D25	8	14	35	47	30	3.57	0.26	26
D3	16	10	27	44	37	3.57	0.25	27
D32	9	22	30	30	43	3.57	0.25	28
D19	9	11	43	37	34	3.57	0.25	29
D11	15	10	30	43	36	3.56	0.24	30
D15	11	8	48	32	35	3.54	0.21	31
D14	7	10	54	31	32	3.53	0.20	32
D30	9	13	46	31	35	3.52	0.19	33
D29	6	16	51	29	32	3.49	0.14	34
D36	7	27	34	30	36	3.46	0.10	35
D8	10	21	42	30	31	3.38	0.00	36

Note: Normalised value = (mean – minimum mean)/(maximum mean – minimum mean). The critical SC factor of EMs are highlighted in bold.

After identifying the 18 critical safety communication factors of EMs, a comparison of critical SC factors of EMs between Hong Kong and Australia was examined using independent-samples *t*-test. Referring to the *t*-test results in Table 5.3, EMs in Hong Kong and Australia did not show a significant level of difference in the mean critical SC factors except for D26 "Employment of safety staff from workers' origin country" The mean D26 of EMs in Australia (M = 4.05) was significantly higher than that of EMs in Hong Kong (M = 3.61). This reflects that the EMWs in Australia perceived that employment of safety staff from workers' origin country was more important than EMWs in Hong Kong.

Table 5.3 *T*-test with the mean critical SC factors of EMs

Code	Mean		t	df	p	Mean Difference
	Hong Kong (N = 76)	Australia (N = 58)				
D5	4.01	4.28	-1.819	132	0.071	-0.263
D6	4.09	4.05	0.236	100.256	0.814	0.040
D4	3.96	4.21	-1.633	104.690	0.105	-0.246
D21	3.91	4.00	-0.686	132	0.494	-0.092
D24	3.97	4.00	-0.179	132	0.858	-0.026
D10	3.95	4.03	-0.548	132	0.585	-0.087
D1	3.99	3.97	0.144	132	0.886	0.021
D34	3.89	4.07	-0.967	132	0.335	-0.174
D9	3.93	4.00	-0.466	132	0.642	-0.066
D22	4.14	3.91	1.587	132	0.115	0.231
D33	3.80	4.10	-1.560	132	0.121	-0.301
D23	3.83	4.05	-1.583	126.778	0.116	-0.223
D13	3.82	4.05	-1.585	132	0.115	-0.236
D27	3.83	4.02	-1.089	132	0.278	-0.188
D17	3.84	3.98	-0.950	132	0.344	-0.141
D12	3.83	3.98	-1.070	132	0.287	-0.154
D31	3.86	3.90	-0.226	98.739	0.822	-0.041
D26	3.61	4.05	-2.697	132	0.008**	-0.446

Note: Two-tailed test; *p < 0.05; **p < 0.01; ***p < 0.001.

5.4 EFA ON CRITICAL SC FACTORS OF EMS

The 18 items for critical safety communication factors were analysed through EFA to determine the underlying structure. The ratio between 134 cases and 18 items was 7.4, which was greater than the ratio of 5.00 suggested by Gorsuch (1983), indicating the sample size was sufficient to conduct EFA. Futhermore, the KMO value was 0.916 (see Table 5.4), which indicated excellent sampling adequacy for factor analysis (Kaiser, 1960). Bartlett's test of sphericity produced an approximation of chi-square 1921.020 ($df = 153$, $p < 0.001$) (see Table 5.4), which supported the normal distribution assumption. Hence, the data on safety communication factors collected in this study were suitable to conduct EFA.

Table 5.4 KMO and Bertlett's test result

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.916
Bartlett's Test of Sphericity	Approx. Chi-Square	1921.020
	df	153
	Significance	0.000

Note: *df* = Degree of freedom.

PCA was carried out and the results indicated that three constructs with eigenvalues were higher than 1. The scree-plot showed that there were three SC factors to retain (see Figure 5.1). The eigenvalues in successive pairs from PCA and PA are reported in Table 5.5. As 1.392 is less than 1.444, the result of parallel analysis suggested that the third factor would not be extracted and the number of factors to retain was two. Since the results of the number of factors to retain derived from three methods were conflicting, the interpretability of factors was used as the deciding criteria, as suggested by Fabrigar and Wegener (2011). The result showed that the optimal solution was three factors, as the items loading on each factor had a conceptual meaning and items loading on different factors measured different constructs.

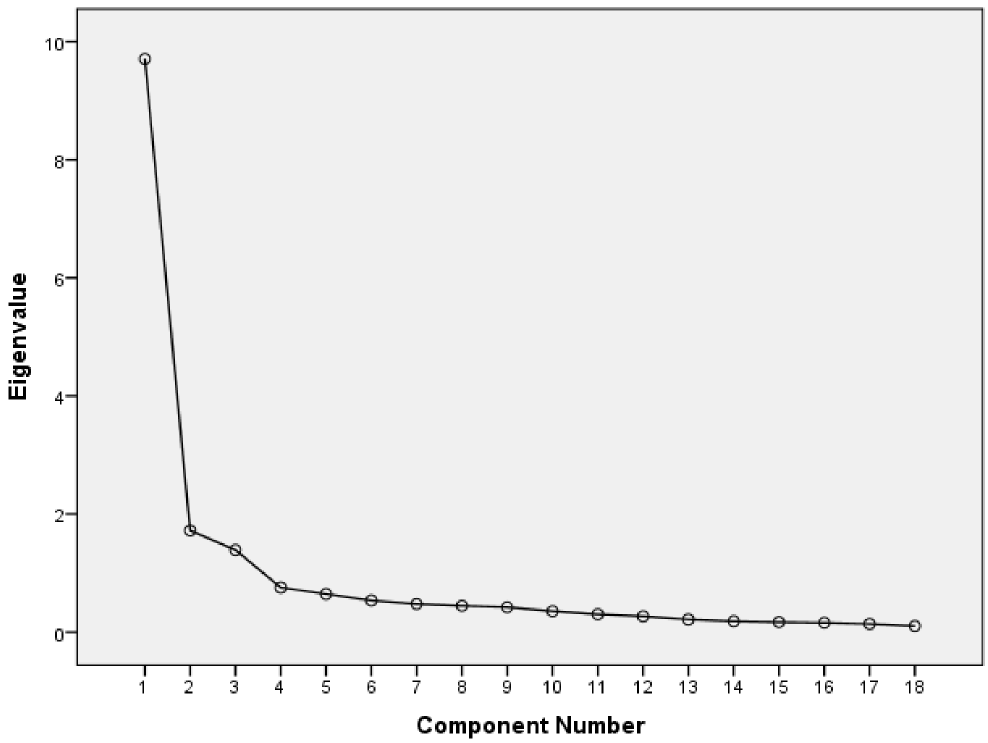

Figure 5.1 Scree plot of EFA

Table 5.5 Comparison of the Eigenvalues from PCA and the Criteria Values form HPA

Construct number	Actual eigenvalue from PCA	Random order eigenvalue from PA	Decision
1	9.708	1.700	Accept
2	1.721	1.557	Accept
3	1.392	1.444	Reject
4	0.755	1.352	Reject

As shown in Table 5.7, the maximum factor correlation coefficient between each factor was 0.568 (higher than 0.32). Thus, oblique rotation was selected according to the criteria recommended by Nunally and Bernstein (1994) and Tabachnick and Fidell (2001). With the help of direct oblimin rotation, a total of three SC constructs were extracted. The rotated pattern and structure matrix of the three SC constructs for EMWs are presented in Table 5.6.

Table 5.6 Rotated factor matrix for PCA of SC factors for EMs

Variables		Pattern coefficients			Structure coefficients			Communalities
		WFEM	MFEM	OFEM	WFEM	MFEM	OFEM	
Group 1: Worker-related SC factors of EMs (WFEM) (eigenvalue = 9.708, % of variance explained = 53.935, cumulative % = 53.935)								
D1	Adequacy of workers' understanding of culture in host country	0.064	**-0.709**	0.103	0.522	**-0.802**	0.531	0.656
D4	Having work experience in construction	-0.194	**-0.893**	0.103	0.369	**-0.840**	0.494	0.730
D5	Adequacy of language ability of workers	0.085	**-0.858**	0.023	0.585	**-0.918**	0.545	0.850
D6	Personality characteristics of workers	0.114	**-0.852**	-0.142	0.522	**-0.839**	0.394	0.719
D9	Good emotional state of workers	0.097	**-0.852**	-0.010	0.575	**-0.901**	0.516	0.818
D10	Providing feedback from workers to management	0.033	**-0.829**	0.064	0.539	**-0.884**	0.543	0.786
Group 2: Management staff-related SC factors of EMs (MFEM) (eigenvalue = 1.721, % of variance explained = 9.564, cumulative % = 63.498)								
D12	Appropriation of communication style of management	**0.660**	-0.082	0.129	**0.776**	-0.529	0.532	0.624
D13	Avoiding using too much technical terminology and difficult words by management	**0.779**	-0.007	0.003	**0.784**	-0.451	0.428	0.615
D17	Active and careful listening to workers	**0.751**	0.085	0.149	**0.783**	-0.425	0.508	0.628
D21	Building trust within the team	**0.794**	-0.079	-0.068	**0.802**	-0.492	0.405	0.648
D22	Relevance and accuracy of safety information provided by management	**0.866**	0.021	-0.084	**0.809**	-0.424	0.373	0.660
D23	Cultural sensitivity and competence of management	**0.746**	-0.123	0.051	**0.843**	-0.575	0.522	0.725
D24	High quality of supervisor-subordinate relationship	**0.808**	-0.025	0.083	**0.867**	-0.530	0.534	0.758
Group 3: Organisation-related SC factors of EMs (OFEM) (eigenvalue = 1.392, % of variance explained = 7.731, cumulative % = 71.229)								
D26	Employment of safety staff from workers' origin country	0.276	-0.077	**0.542**	0.613	-0.535	**0.734**	0.608
D27	Application of pictorial or visual safety materials	0.020	-0.064	**0.851**	0.516	-0.548	**0.897**	0.808
D31	Adequacy and appropriateness of safety trainings	0.145	-0.193	**0.555**	0.555	-0.584	**0.741**	0.605
D33	Organisational support and concern	-0.094	-0.083	**0.901**	0.441	-0.531	**0.897**	0.811
D34	No much time pressure for completion of the project	0.068	0.103	**0.895**	0.494	-0.433	**0.875**	0.772

Note: Major loadings for each variable are shown in bold. WFEM refers to Workers-related SC factors of EMs; MFEM refers to Management staff-related factors of EMs; OFEM refers to Organization-related SC factors of EMs.

The first group of SC factors was labelled "Workers-related SC factors of EMs" (WFEM) and comprised six variables. The second group of SC factors was labelled "Management staff-related SC factors of EMs" (MFEM) and consisted of seven items. The third group of SC factors was labelled "Organisation-related SC factors of EMs" (OFEM) and included five items. The Cronbach's alpha values for WFEM, MFEM, and OFEM were 0.932, 0.914, and 0.895, as listed in Table 5.7.

Table 5.7 Factor correlation coefficient and Cronbach's alpha

Groups	Variables number	Cronbach's alpha	Factor correlations		
			1	2	3
WFEM	6	0.932	1.000		
MFEM	7	0.914	0.568	1.000	
OFEM	5	0.895	0.541	0.556	1.000

Note: Extraction method: principal component analysis; rotation method: direct oblimin rotation. WFEM refers to Workers-related SC factors of EMs; MFEM refers to Management staff-related factors of EMs; OFEM refers to Organization-related SC factors of EMs.

5.5 EFA ON TWO DETERMINANTS AND TWO INDICATORS OF SAFETY PERFORMANCE

The six variables for the two determinants of safety behaviours (DSP) and six variables for indicators of safety performance (SP) were subjected to EFA using PCA. As shown in Table 5.8, the KMO value for both scales was higher than 0.80, indicating a meritorious sampling adequacy for factor analysis (Kaiser, 1960). Bartlett's test of sphericity produced an approximation of chi-square 811.585 ($df = 15$, $p < 0.001$) (see Table 5.8) and 689.589 ($df = 15$, $p < 0.001$), respectively for the scales of DSP and SP, supporting the normal distribution assumption.

Table 5.8 KMO and Bertlett's test result of DSP and SP

Measures		DSP	SP
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.836	0.838
Bartlett's Test of Sphericity	Approx. Chi-Square	811.585	689.589
	df	15	15
	Significance	0.000	0.000

Note: df = Degree of freedom.

The results of the eigenvalues and scree-plot determined that the number of constructs to retain for DSP and SP measurement scale was two. The factor correlation coefficient between two factors for DSP and SP were 0.610 and 0.595 respectively, higher than 0.32. Thus, direct oblimin rotation was selected to rotate the factors. Table 5.9 and Table 5.10 present rotated pattern and structure matrix of the constructs of DSP ad SP.

As shown in Table 5.9, the DSP measurement scale achieved a high cumulative variance of 89.890 and attained an overall Cronbach's alpha value of 0.941. The first factor of DSP was labelled "safety knowledge" (KNOWL) and accounted for 72.435 % of the variance and was composed of three variables. The second factor of DSP was labelled "safety motivation" (MOTIV) and accounted for 17.456% of the variance and consisted of three variables. The Cronbach's alpha values for KNOWL and MOTIV were 0.932 and 0.932, respectively. The mean value of KNOWL and MOTIV was 3.664 and 3.639, respectively.

The SP measurement scale also achieved a high cumulative variance of 87.132% and attained an overall Cronbach's alpha value of 0.913 (see Table 5.10). As for the factor structure of SP, the first factor was labelled "safety compliance" (COMP) and accounted for 69.748% of the variance and was composed of three variables. The second factor was labelled "safety participation" (PART) and consisted of three variables, accounting 17.384% of the variance. The Cronbach's alpha values for COMP and PART were 0.906 and 0.944, respectively. The mean value of COMP and PART was 3.769 and 3.572, respectively.

Table 5.9 Rotated factor matrix for PCA of two-factor solution of DSP

	Variables	Pattern coefficients		Structure coefficients		Communalities
		KNOWL	MOTIV	KNOWL	MOTIV	
KNOWL: Safety knowledge (eigenvalue = 4.346, % of variance explained = 72.435, Cronbach's alpha = 0.932, mean = 3.664)						
C1	I know how to perform my job in a safe manner	0.026	**0.918**	0.586	**0.934**	0.872
C2	I know how to use safety equipment and standard work procedures	-0.013	**0.951**	0.567	**0.942**	0.888
C3	I know how to reduce the risk of accidents and incidents in the workplace	-0.010	**0.952**	0.571	**0.946**	0.894
MOTIV: Safety motivation (eigenvalue = 1.047, % of variance explained = 17.456, Cronbach's alpha = 0.939, mean = 3.639)						
C4	I believe that safety at workplace is a very important issue	**0.971**	-0.008	**0.967**	0.585	0.934
C5	I feel that it is important to encourage others to use safe practices	**0.954**	-0.016	**0.945**	0.567	0.893
C6	I feel that it is important to promote safety programmes	**0.938**	0.027	**0.955**	0.600	0.912
Mean score = 3.652 Cronbach's alpha = 0.941 Cumulative % = 89.890						

Note: Extraction method: principal component analysis; rotation method: oblimin with Kaiser Normalization; major loadings for each variable are shown in boldface.

Table 5.10 Rotated factor matrix for PCA of two-factor solution of SP

Variable		Pattern coefficients		Structure coefficients		Communalities
		COMP	PART	COMP	PART	
COMP: Safety compliance (eigenvalue = 4.185, % of variance explained = 69.748, Cronbach's alpha = 0.906, mean = 3.769)						
C7	I use all necessary safety equipment to do my job	-0.052	**0.949**	0.513	**0.918**	0.844
C8	I follow correct safety rules and procedures while carrying out my job	0.041	**0.891**	0.571	**0.916**	0.839
C9	I ensure the highest levels of safety when I carry out my job	0.026	**0.903**	0.564	**0.919**	0.845
PART: Safety participation (eigenvalue = 1.043, % of variance explained = 17.384, Cronbach's alpha = 0.944, mean = 3.572)						
C10	I put extra effort to improve the safety of the workplace	**0.915**	0.054	**0.947**	0.599	0.899
C11	I voluntarily carryout tasks or activities that help to improve workplace safety	**0.961**	-0.014	**0.952**	0.557	0.907
C12	I encourage my co-workers to work safely	**0.961**	-0.027	**0.945**	0.545	0.893
Mean score = 3.670 Cronbach's alpha = 0.913 Cumulative % = 87.132						

Note: Extraction Method: principal component analysis; Rotation method: oblimin with Kaiser Normalization; major loadings for each variable are shown in boldface

5.6 EMPIRICAL RESULTS OF THE MEASUREMENT MODELS

In order to test the direct and indirect effects of safety communication factors on the safety performance of the EMs, structural equation models 1, 2, and 3 were hypothesised. The details of these three models are described in Sections 5.7, 5.8, and 5.9. Both the measurement model and structural model were evaluated to analyse the proposed three models. The measurement model shows the relationships between unobserved variables and observed variables, while the structural model depicts the relationship among unobserved variables.

The latent variables involved in these three models are listed as follows:

- Worker-related SC factors of EMs (WFEM). This latent variable was an exogenous construct and was measured by seven observed variables.
- Management staff-related SC factors of EMs (MFEM). This latent variable was an exogenous construct and was measured by seven observed variables.
- Organisation-related SC factors of EMs (OFEM). This latent variable was an exogenous construct and was measured by five observed variables.
- Safety knowledge (KNOWL). This latent variable was a mediating construct and was measured by three observed variables.
- Safety motivation (MOTIV). This latent variable was a mediating construct and was measured by three observed variables.
- Safety compliance (COMP). This latent variable was an endogenous construct and was measured by three observed variables.
- Safety participation (PART). This latent variable was an endogenous construct and was measured by three observed variables.

The reliability and validity of the seven latent constructs used in the three structural equation models were tested, as shown in Table 5.11.

Table 5.11 Reliability and validity measure of seven constructs in three models

Latent variables	Cronbach alpha	CR	WFEM	MFEM	OFEM	KNOWL	MOTIV	COMP	PART
WFEM	0.932	0.934	**0.704**						
MFEM	0.914	0.914	*0.694* (0.482)	**0.602**					
OFEM	0.895	0.898	*0.684* (0.468)	*0.693* (0.480)	**0.639**				
KNOWL	0.932	0.933	*0.679* (0.461)	*0.695* (0.483)	*0.675* (0.456)	**0.823**			
MOTIV	0.939	0.940	*0.658* (0.433)	*0.694* (0.482)	*0.649* (0.421)	*0.792* (0.627)	**0.838**		
COMP	0.906	0.903	*0.569* (0.324)	*0.568* (0.323)	*0.541* (0.293)	*0.716* (0.513)	*0.691* (0.477)	**0.755**	
PART	0.944	0.941	*0.595* (0.354)	*0.608* (0.370)	*0.566* (0.320)	*0.747* (0.558)	*0.736* (0.542)	*0.653* (0.426)	**0.842**

Note: The values presented in bold along the diagonal were AVE; the values in italic were correlation coefficients of the seven components; the values in brackets were squared correlation coefficients of the seven components. WFEM refers to Workers-related SC factors of EMs; MFEM refers to Management staff-related factors of EMs; OFEM refers to Organization-related SC factors of EMs.

The reliability of the seven constructs were achieved as:

- Cronbach Alpha coefficients of seven latent constructs ranged from 0.895 to 0.944 and were higher than 0.70;
- The proportion of item-item correlation coefficients within each construct ranging within 0.20 to 0.70 was greater than 50% and item-total correlation values were all higher than 0.30;
- The values of CR ranged from 0.898 (for OFEM) to 0.941 (for PART). The CR of all latent constructs were higher than the threshold of 0.70.

The validity of constructs was also achieved as:

- The standardised factor loadings coefficients of all observed variables exceeded the threshold 0.50, as shown in the Table 5.16;
- The values of AVE ranged within 0.602-0.842, which were higher than the suggested threshold 0.50.
- The correlation coefficients among seven components ranged within 0.541-0.747, and the squared correlation coefficients of seven components ranged

from 0.293 to 0.558. The values of AVE in bold along diagonal exceeded the squared correlation coefficients in its rows and columns, indicating that the seven components have adequate discriminant validity.

5.7 DIRECT EFFECTS OF SC FACTORS ON THE SAFETY PERFORMANCE OF EMS

5.7.1 Hypothesised structural equation model 1

Structural equation model 1 was proposed to test the direct effects of three SC factors of EMs on their safety behaviours, including safety compliance and safety participation. The hypothesised model 1 comprised a structural model and five measurement models (see Figure 5.2). The structural model was constructed to measure the direct effects of three latent SC factors on two latent indicators of safety behaviours of EMs. The first three measurement models showed the relationships between three SC factors (i.e., WFEM, MFEM, and OFEM) with their respective observed variables. The other two measurement models depicted the two indicators of safety behaviours (i.e., COMP and PART) and their respective observed variables.

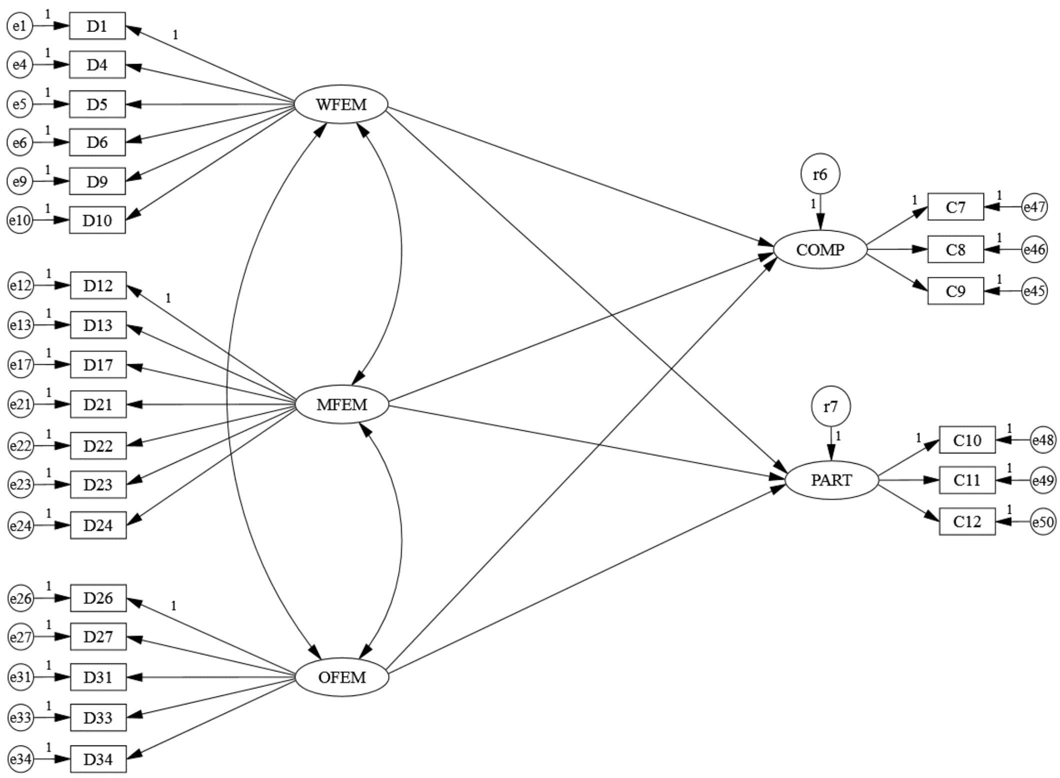

Figure 5.2 Hypothesised structural equation model 1 (Model 1)

Note: Model 1 was hypothesised to test direct effects of SC factors on safety performance of EMs

The WFEM, MFEM, and OFEM were defined as independent variables, and COMP and PART were defined as dependent variables. Six hypotheses were tested as follows:

- H_{1a}: WFEM has a positive direct effect on COMP of EMs.
- H_{1b}: MFEM has a positive direct effect on COMP of EMs.
- H_{1c}: OFEM has a positive direct effect on COMP of EMs.
- H_{2a}: WFEM has a positive direct effect on PART of EMs.
- H_{2b}: MFEM has a positive direct effect on PART of EMs.
- H_{2c}: OFEM has a positive direct effect on PART of EMs.

5.7.2 Empirically tested structural equation model 1

The maximum likelihood estimates for the various parameters of the overall fit in the structural model are shown in Table 5.12. The fit statistics indicate that the hypothesised structural model achieved an acceptable fit that justified no further interpretation. All fit indices in Model 1 achieved the acceptable level (RMSEA = 0.079, IFI = 0.924, TLI = 0.912, CFI = 0.923, PNFI = 0.746, PGFI = 0.647, PCFI = 0.813, χ^2/df = 1.843).

Table 5.12 Goodness-of-fit indices of Model 1

Goodness-of-fit Measures		Model 1	Levels of Acceptable Fit	References
Absolute fit	RMSEA	0.079	< 0.8	Schermelleh-Engel et al., (2003); Xiong et al., (2015)
Incremental fit	IFI	0.924	> 0.9	Bagozzi and Yi, (1988); Hu and Bentler, (1995); Hooper et al., (2008); Xiong et al., (2015)
	TLI	0.912		
	CFI	0.923		
Parsimonious fit	PNFI	0.746	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PGFI	0.647	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PCFI	0.813	> 0.5	Xiong et al., (2015)
	χ^2/df	1.843	< 3.0	Patel and Jha (2016); Xiong et al., (2015)

Table 5.13 and Figure 5.3 present the regression results, including correlation between exogenous constructs, factor loading, standardised factor loading (β), squared multiple correlations (R^2), standardised error (S.E.), the critical ratios (C.R.), and the p-values. Path coefficients on the arrows of structural model indicated the strength of relationships among five latent variables. Model 1 accounted for 41% of the variance in safety compliance and 45% of the variance in safety participation. Four hypotheses (i.e., H_{1a}, H_{1b}, H_{2a}, and H_{2b}) were supported, whereas two hypotheses (i.e., H_{1c} and H_{2c}) were not supported.

Hypothesis H_{1a} was supported: WFEM had a slightly positive direct effect on the safety compliance of EMs (β = 0.263, t = 2.114, p < 0.05). The standardised path coefficient from WFEM to COMP was 0.263, indicating that one unit of increase in the WFEM contributed to around 0.263 unit of increase in the COMP of EMs.

Hypothesis H_{1b} was supported: The direct relationship between MFEM and COMP was significantly positive (β = 0.270, t = 2.072, p < 0.05). The standardised path coefficient from MFEM to COMP was 0.270, indicating that one unit of increase in MFEM contributed to approximately 0.270 unit of increase in the COMP of EMs.

Hypothesis H_{1c} was not supported: The direct relationship between OFEM and COMP of EMs was not found (β = 0.181, t = 1.400, p > 0.05).

Hypothesis H_{2a} was supported: WFEM showed a significantly positive correlation with PART (β = 0.265, t = 2.280, p < 0.05). The standardised path coefficient from MFEM to PART was 0.265, indicating that one unit of increase in MFEM contributed to approximately 0.265 unit of increase in the PART of EMs.

Hypothesis H_{2b} was supported: MFEM showed a significantly positive correlation with COMP (β = 0.307, t = 2.509, p < 0.05). The standardised path coefficient from MFEM to PART was 0.307, indicating that one unit of increase in MFEM contributed to approximately 0.307 unit of increase in the PART of EMs.

Hypothesis H_{2c} was not supported: The direct relationship between OFEM and PART was not found (β = 0.179, t = 1.490, p > 0.05).

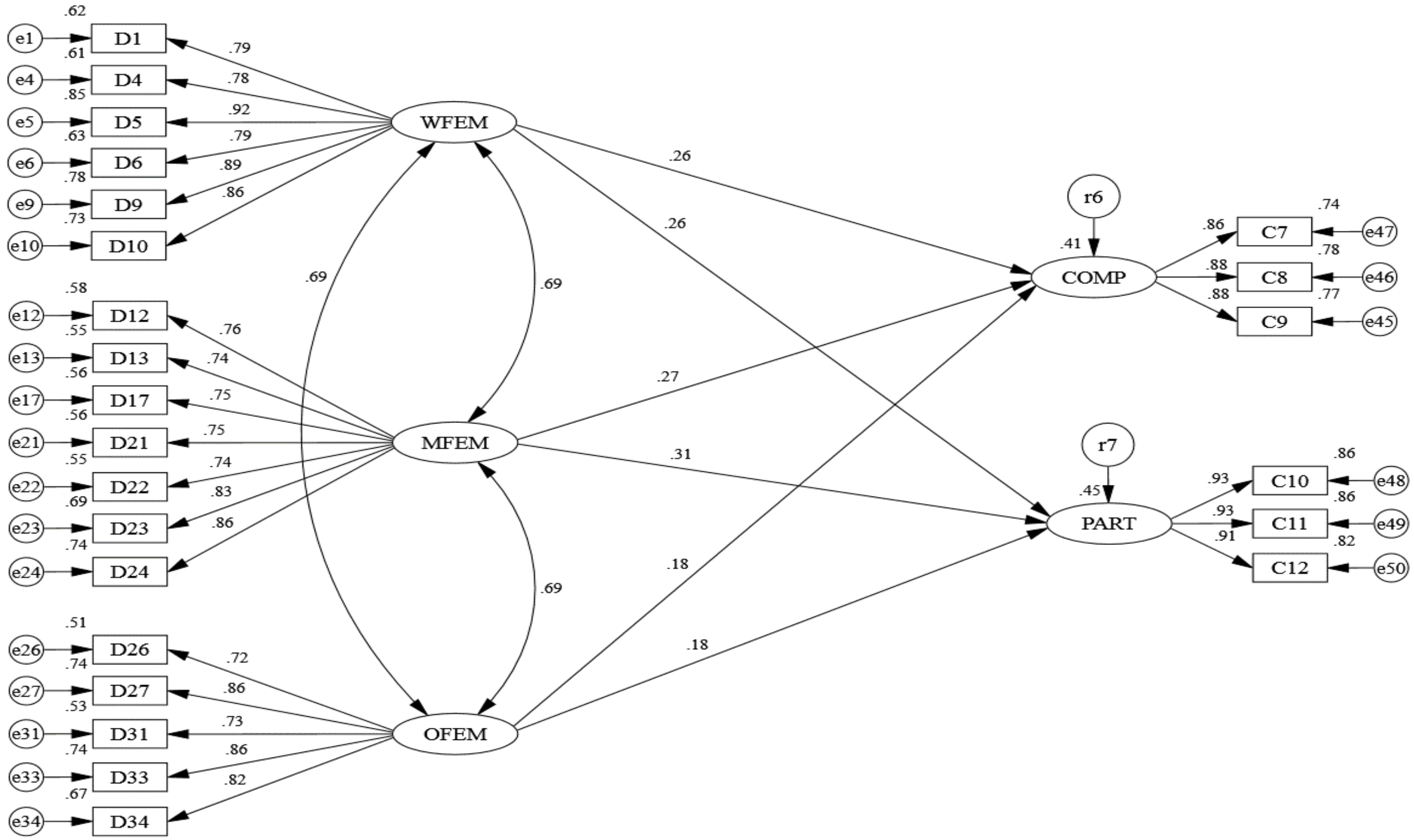

Figure 5.3 Model 1 with standardised path coefficients

Note: Model 1 was hypothesised to test direct effects of three SC factors on safety performance of EMs; Path estimate are standardised coefficients; R^2 = Squared multiple correlations; Two-tailed test.

Table 5.13 Regression weights for each path and its significance in Model 1

Path			Factor loading	β	R^2	S.E.	C.R.	*p*
COMP	⟵	WFEM	0.207	0.263		0.098	2.114	*
COMP	⟵	MFEM	0.226	0.270	0.406	0.109	2.072	*
COMP	⟵	OFEM	0.136	0.181		0.097	1.400	n.s.
PART	⟵	WFEM	0.254	0.265		0.111	2.280	*
PART	⟵	MFEM	0.312	0.307	0.451	0.124	2.509	*
PART	⟵	OFEM	0.164	0.179		0.110	1.490	n.s.
D1	⟵	WFEM	1.000	0.788	0.514	–	–	–
D4	⟵	WFEM	0.986	0.779	0.621	0.100	9.856	***
D5	⟵	WFEM	1.160	0.924	0.783	0.093	12.416	***
D6	⟵	WFEM	1.116	0.791	0.626	0.111	10.070	***
D9	⟵	WFEM	1.074	0.885	0.535	0.090	11.920	***
D10	⟵	WFEM	1.170	0.856	0.733	0.103	11.305	***
D12	⟵	MFEM	1.000	0.762	0.580	–	–	–
D13	⟵	MFEM	1.016	0.744	0.553	0.115	8.832	***
D17	⟵	MFEM	1.006	0.745	0.555	0.113	8.927	***
D21	⟵	MFEM	0.919	0.751	0.564	0.102	9.005	***
D22	⟵	MFEM	0.987	0.739	0.546	0.112	8.784	***
D14	⟵	MFEM	1.080	0.829	0.686	0.107	10.097	***
D24	⟵	MFEM	1.151	0.860	0.74	0.110	10.484	***
D26	⟵	OFEM	1.000	0.717	0.607	–	–	–
D27	⟵	OFEM	1.227	0.862	0.742	0.130	9.405	***
D31	⟵	OFEM	1.049	0.731	0.735	0.128	8.183	***
D33	⟵	OFEM	1.369	0.858	0.854	0.149	9.178	***
D34	⟵	OFEM	1.215	0.819	0.671	0.135	8.965	***
C9	⟵	COMP	1.069	0.878	0.772	0.083	12.900	***
C8	⟵	COMP	1.076	0.884	0.781	0.084	12.822	***
C7	⟵	COMP	1.000	0.858	0.736	–	–	–
C10	⟵	PART	1.000	0.928	0.861	–	–	–
C11	⟵	PART	0.984	0.929	0.863	0.053	18.740	***
C12	⟵	PART	0.958	0.908	0.824	0.055	17.544	***

Note: β = Standardised factor loading; S.E. = standardized error; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, n.s. represents not significant, $p > 0.05$; C.R. = critical ratio (t value); R^2 = Squared multiple correlations.

5.8 DIRECT EFFECTS OF SAFETY KNOWLEDGE AND MOTIVATION ON THE SAFETY PERFORMANCE OF EMS

5.8.1 Hypothesised structural equation model 2

Structural equation model 2 was proposed to test the direct effects of the safety knowledge and safety motivation of EMs on their safety behaviours, including safety compliance and safety participation. As shown in Figure 5.4, the hypothesised model 2 comprised a structural model and four measurement models. The first two measurement models showed the relationships between KNOWL and MOTIV with their respective observed variables. The other two measurement models depicted the two indicators of safety behaviours (i.e., COMP and PART) and their respective observed variables. The structural model was constructed to measure the direct effects of KNOWL and MOTIV on two latent indicators of safety behaviours of EMs. KNOWL and MOTIV were independent variables, while COMP and PART were dependent variables. Four hypotheses were tested as follows:

- H_{3a}: KNOWL has a positive direct effect on COMP of EMs.
- H_{3b}: MOTIV has a positive direct effect on COMP of EMs.
- H_{4a}: KNOWL has a positive direct effect on PART of EMs.
- H_{4b}: MOTIV has a positive direct effect on PART of EMs.

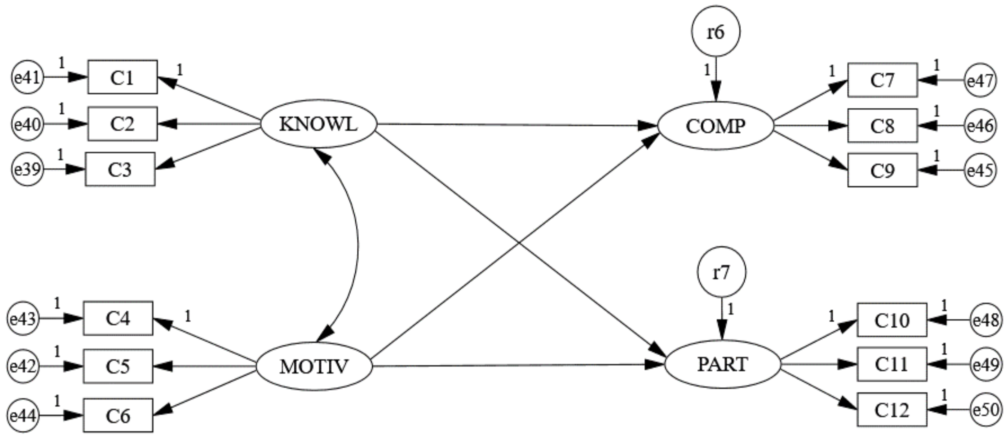

Figure 5.4 Hypothesised structural equation model 2 (Model 2)

Note: Model 2 was hypothesised to test direct effects of safety knowledge and safety motivation on safety performance of EMs.

5.8.2 Empirically tested structural equation model 2

Structural model 2 exhibited a good fit with the data collected (see Table 5.14). All fit indices in Model 1 achieved the acceptable level (RMSEA = 0.039, IFI = 0.984, TLI = 0.982, CFI = 0.984, PNFI = 0.716, PGFI = 0.586, PCFI = 0.738, and χ^2/df = 1.203).

Table 5.14 Goodness-of-fit of Model 2

Goodness-of-fit Measures		Model 2	Levels of Acceptable Fit	References
Absolute fit	RMSEA	0.039	< 0.8	Schermelleh-Engel et al., (2003); Xiong et al., (2015)
Incremental fit	IFI	0.984	> 0.9	Bagozzi and Yi, (1988); Hu and Bentler, (1995); Hooper et al., (2008); Xiong et al., (2015)
	TLI	0.982		
	CFI	0.984		
Parsimonious fit	PNFI	0.716	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PGFI	0.586	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PCFI	0.738	> 0.5	Xiong et al., (2015)
	χ^2/df	1.203	< 3.0	Patel and Jha (2016); Xiong et al., (2015)

Figure 5.5 and Table 5.15 present the regression results. As shown in Table 5.15, the values of R^2 of COMP and PART were 0.562 and 0.619, respectively, representing that 56.2% of COMP and 61.9% of PART could be measured by using KNOWL and MOTIV. All four hypotheses (i.e., H_{3a}, H_{3b}, H_{4a}, and H_{4b}) in Model 2 were supported.

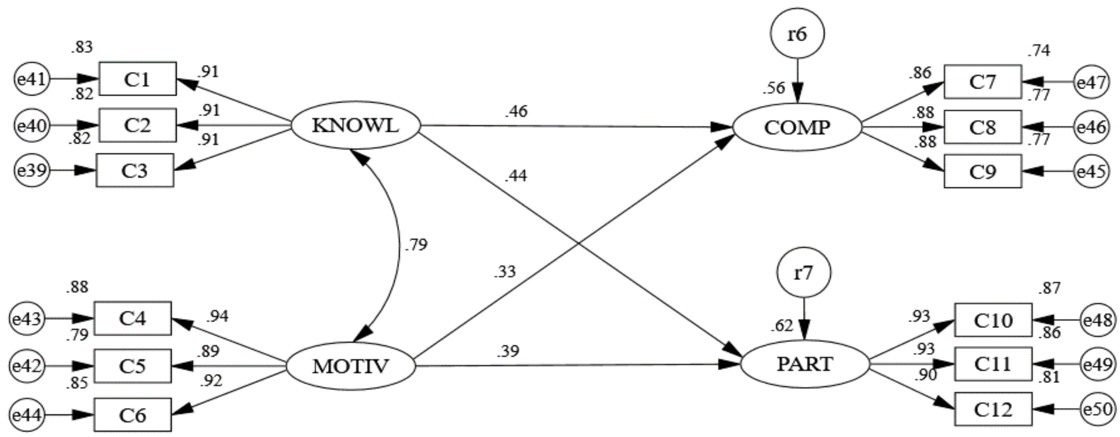

Figure 5.5 Model 2 with standardised path coefficients

Note: Path estimate are standardised coefficients; R^2 = Squared multiple correlations; Two-tailed test.

Table 5.15 Regression weights for each path and its significance in Model 2

Path			Factor loading	β	R^2	S.E.	C.R.	p
COMP	⟵	KNOWL	0.483	0.458	0.562	0.132	3.671	***
COMP	⟵	MOTIV	0.317	0.333		0.118	2.682	**
PART	⟵	KNOWL	0.567	0.442	0.619	0.145	3.904	***
PART	⟵	MOTIV	0.451	0.389		0.129	3.505	***
C3	⟵	KNOWL	1.131	0.906	0.820	0.069	16.447	***
C2	⟵	KNOWL	1.085	0.907	0.824	0.066	16.489	***
C1	⟵	KNOWL	1.000	0.909	0.827	–	–	–
C5	⟵	MOTIV	1.014	0.887	0.786	0.060	17.019	***
C4	⟵	MOTIV	1.000	0.938	0.880	–	–	–
C6	⟵	MOTIV	1.048	0.922	0.850	0.055	19.117	***
C9	⟵	COMP	1.067	0.880	0.775	0.082	13.093	***
C8	⟵	COMP	1.067	0.880	0.774	0.082	13.008	***
C7	⟵	COMP	1.000	0.861	0.741	–	–	–
C10	⟵	PART	1.000	0.932	0.868	–	–	–
C11	⟵	PART	0.981	0.930	0.864	0.052	19.018	***
C12	⟵	PART	0.948	0.902	0.813	0.054	17.537	***

Note: β = Standardised factor loading; S.E. = standardised error; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, n.s. represents not significant, $p > 0.05$; C.R. = critical ratio (t value); R^2 = Squared multiple correlations.

Hypothesis H_{3a} was supported: KNOWL has a significantly positive direct effect on the COMP of EMs ($\beta = 0.458$, $t = 3.671$, $p < 0.001$). The estimated weight indicates that when KNOWL went up by 1 the COMP of EMs changed by 0.458.

Hypothesis H_{3b} was supported: The direct relationship between MOTIV and COMP was significantly positive ($\beta = 0.333$, $t = 2.682$, $p < 0.01$). The standardised path coefficient from MOTIV to COMP was 0.333, indicating that one unit of increase in MOTIV contributed to approximately 0.333 unit of increase in the COMP of EMs.

Hypothesis H_{4a} was supported: The direct relationship between KNOWL and PART was significantly positive ($\beta = 0.442$, $t = 3.904$, $p < 0.001$). The standardised path coefficient from KNOWL to PART was 0.442, indicating that one unit of increase in KNOWL contributed to approximately 0.442 unit of increase in the PART of EMs.

Hypothesis H_{4b} was supported. MOTIV showed a significantly positive correlation with PART ($\beta = 0.389$, $t = 3.505$, $p < 0.001$). The standardised path coefficient from

MOTIV to PART was 0.389, indicating that one unit of increase in MOTIV contributed to approximately 0.389 unit of increase in the PART of EMs.

5.9 INDIRECT EFFECTS OF SC FACTORS ON THE SAFETY PERFORMANCE OF EMS

5.9.1 Hypothesised structural equation model 3

Structural equation model 3 was proposed to test the indirect effects of three SC factors of EMs on their safety behaviours, including safety compliance and safety participation. Compared with Model 1, the mediators of safety knowledge and safety motivation were added in Model 3. As shown in Figure 5.6, hypothesised model 3 comprised a structural model and five measurement models. Model 3 consisted of seven measurement models, among which five measurement models (i.e., WFEM, MFEM, OFEM, COMP, and PART) were same as Model 1 and two measurement models (i.e., KNOWL and MOTIV) were same as Model 2. The structural model in Model 3 depicted the direct effects and indirect effects of three latent SC factors on two latent indicators of safety behaviours of EMs. WFEM, MFEM, and OFEM were independent variables, KNOWL and MOTIV were mediators, and COMP and PART were dependent variables. Six hypotheses were tested as follows:

- H_{1a}: WFEM has a positive indirect effect on COMP of EMs.
- H_{1b}: MFEM has a positive indirect effect on COMP of EMs.
- H_{1c}: OFEM has a positive indirect effect on COMP of EMs.
- H_{1d}: WFEM has a positive indirect effect on PART of EMs.
- H_{1e}: MFEM has a positive indirect effect on PART of EMs.
- H_{1f}: OFEM has a positive indirect effect on PART of EMs.

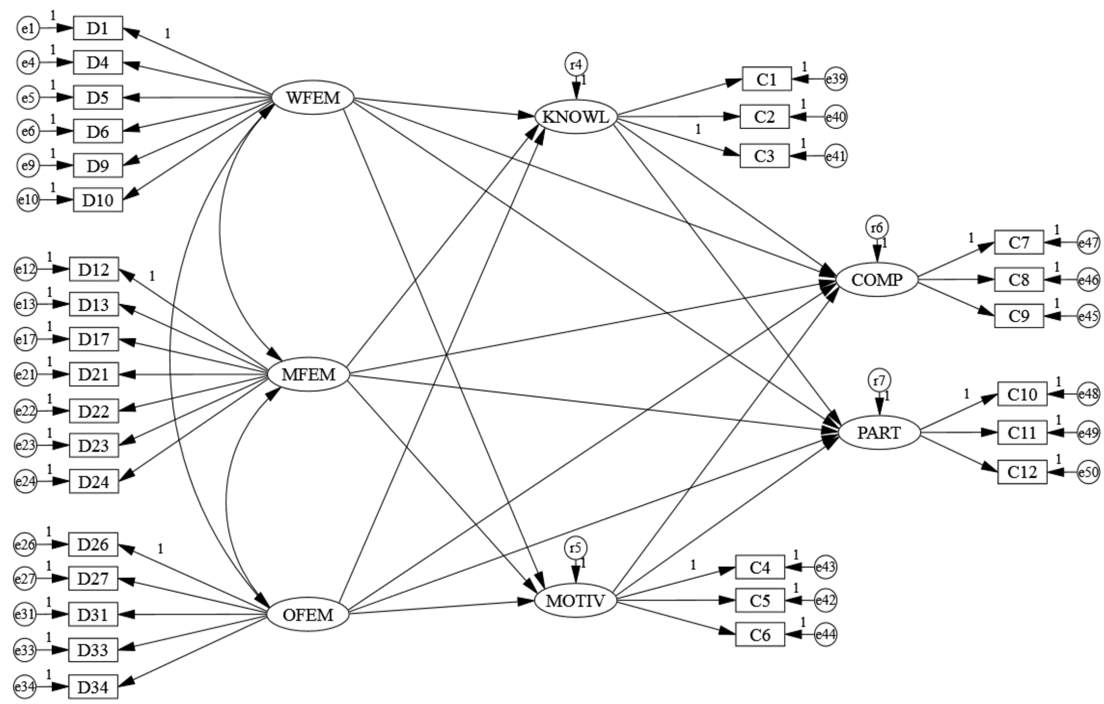

Figure 5.6 Hypothesised structural equation model 3 (Model 3)

Note: Model 3 was hypothesised to test indirect effects of three SC factors on safety performance of EMs.

5.9.2 Empirically tested structural equation model 3

Structural model 3 exhibited a good fit with the data collected. The values of goodness-of-fit of structural equation model 3 are presented in Table 5.16. All fit indices in Model 3 achieved the acceptable level (RMSEA = 0.069, IFI = 0.934, TLI = 0.924, CFI = 0.933, PNFI = 0.750, PGFI = 0.644, PCFI = 0.828, χ^2/df = 1.636).

Table 5.16 Goodness-of-fit of Model 3

Goodness-of-fit Measures		Model 3	Levels of Acceptable Fit	References
Absolute fit	RMSEA	0.069	< 0.8	Schermelleh-Engel et al., (2003); Xiong et al., (2015)
Incremental fit	IFI	0.934	> 0.9	Bagozzi and Yi, (1988); Hu and Bentler, (1995); Hooper et al., (2008); Xiong et al., (2015)
	TLI	0.924		
	CFI	0.933		
Parsimonious fit	PNFI	0.750	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PGFI	0.644	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PCFI	0.828	> 0.5	Xiong et al., (2015)
	χ^2/df	1.636	< 3.0	Patel and Jha (2016); Xiong et al., (2015)

The regression results, including correlations between exogenous constructs, factor loading, standardised factor loading (*β*), squared multiple correlations (R^2), standardised error (S.E.), the critical ratios (C.R.), and the *p*-values are presented in Table 5.17 and Figure 5.7. Model 3 accounted for 55% of the variance in safety compliance and 61% of the variance in safety participation. The indirect and direct effects of exogenous variables on endogenous variables are depicted in Table 5.18. The testing results of the mediators (KNOWL and MOTIV) are presented in Table 5.19. The results show that all six hypotheses were supported.

Table 5.17 Regression weights for each path and its significance in Model 3

Path			Factor loading	*β*	R^2	S.E.	C.R.	*p*
KNOWL	⟵	WFEM	0.223	0.264		0.087	2.551	**
KNOWL	⟵	MFEM	0.306	0.342	0.609	0.098	3.123	**
KNOWL	⟵	OFEM	0.220	0.270		0.089	2.486	*
MOTIV	⟵	WFEM	0.204	0.243		0.088	2.328	*
MOTIV	⟵	MFEM	0.334	0.376	0.584	0.098	3.394	***
MOTIV	⟵	OFEM	0.190	0.235		0.088	2.149	*
COMP	⟵	KNOWL	0.402	0.437		0.121	3.324	***
COMP	⟵	MOTIV	0.310	0.334		0.116	2.677	**
COMP	⟵	WFEM	0.054	0.069	0.545	0.089	0.599	n.s.
COMP	⟵	MFEM	0.000	0.000		0.104	-0.003	n.s.
COMP	⟵	OFEM	-0.005	-0.007		0.090	-0.057	n.s.
PART	⟵	MOTIV	0.436	0.387		0.125	3.476	***
PART	⟵	KNOWL	0.471	0.422		0.133	3.545	***
PART	⟵	WFEM	0.057	0.060	0.606	0.098	0.581	n.s.
PART	⟵	MFEM	0.032	0.032		0.114	0.279	n.s.
PART	⟵	OFEM	-0.020	-0.022		0.099	-0.205	n.s.
D1	⟵	WFEM	1.000	0.788	0.514	–	–	–
D4	⟵	WFEM	0.986	0.779	0.621	0.100	9.856	***
D5	⟵	WFEM	1.160	0.924	0.783	0.093	12.416	***
D6	⟵	WFEM	1.116	0.791	0.626	0.111	10.070	***
D9	⟵	WFEM	1.074	0.885	0.535	0.090	11.920	***
D10	⟵	WFEM	1.170	0.856	0.733	0.103	11.305	***
D12	⟵	MFEM	1.000	0.762	0.580	–	–	–

D13	⟵	MFEM	1.016	0.744	0.553	0.115	8.832	***
D17	⟵	MFEM	1.006	0.745	0.555	0.113	8.927	***
D21	⟵	MFEM	0.919	0.751	0.564	0.102	9.005	***
D22	⟵	MFEM	0.987	0.739	0.546	0.112	8.784	***
D14	⟵	MFEM	1.080	0.829	0.686	0.107	10.097	***
D24	⟵	MFEM	1.151	0.860	0.74	0.110	10.484	***
D26	⟵	OFEM	1.000	0.717	0.607	–	–	–
D27	⟵	OFEM	1.227	0.862	0.742	0.130	9.405	***
D31	⟵	OFEM	1.049	0.731	0.735	0.128	8.183	***
D33	⟵	OFEM	1.369	0.858	0.854	0.149	9.178	***
D34	⟵	OFEM	1.215	0.819	0.671	0.135	8.965	***
D37	⟵	OFEM	1.239	0.859	0.737	0.134	9.258	***
C1	⟵	KNOWL	0.893	0.911	0.831	0.055	16.187	***
C2	⟵	KNOWL	0.972	0.912	0.832	0.059	16.355	***
C3	⟵	KNOWL	1.000	0.898	0.807	–	–	–
C4	⟵	MOTIV	1.007	0.885	0.784	0.059	17.039	***
C5	⟵	MOTIV	1.000	0.943	0.889	–	–	–
C6	⟵	MOTIV	1.038	0.918	0.842	0.055	19.038	***
C9	⟵	COMP	1.067	0.875	0.766	0.082	13.074	***
C8	⟵	COMP	1.069	0.876	0.768	0.082	13.003	***
C7	⟵	COMP	1.000	0.856	0.732	–	–	–
C10	⟵	PART	1.000	0.928	0.862	–	–	–
C12	⟵	PART	0.949	0.899	0.858	0.054	17.554	***
C11	⟵	PART	0.981	0.926	0.684	0.052	19.002	***

Note: β = Standardised factor loading; S.E. = standardised error; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, n.s. represents not significant, $p > 0.05$; C.R. = critical ratio (t value); R^2 = Squared multiple correlations.

Table 5.18 Direct, indirect, and total effects in Model 3

Endogenous variables	Exogenous variables	Standardised direct effects		Standardised indirect effects		Standardised total effects	
		Estimate	*p*	Estimate	*p*	Estimate	*p*
KNOWL	WFEM	0.264	0.034*	–	–	0.264	0.034*
	MFEM	0.342	0.029*	–	–	0.342	0.029*
	OFEM	0.270	0.029*	–	–	0.270	0.029*
MOTIV	WFEM	0.243	0.065	–	–	0.243	0.065

	MFEM	0.376	0.028*	–	–	0.376	0.028*
	OFEM	0.235	0.091	–	–	0.235	0.091
COMP	WFEM	0.069	0.634	0.197	0.018*	0.265	0.062
	MFEM	0.000	0.958	0.275	0.023*	0.275	0.089
	OFEM	-0.007	0.923	0.197	0.039*	0.190	0.157
	KNOWL	0.437	0.011*	–	–	0.437	0.011*
	MOTIV	0.334	0.035	–	–	0.334	0.035*
PART	WFEM	0.060	0.711	0.206	0.020*	0.266	0.054
	MFEM	0.032	0.781	0.290	0.029*	0.322	0.098
	OFEM	-0.022	0.914	0.205	0.028*	0.183	0.170
	KNOWL	0.422	0.031*	–	–	0.422	0.031*
	MOTIV	0.387	0.009**	–	–	0.387	0.009**

Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 5.19 Testing results of mediators (KNOWL and MOTIV) in Model 3

Indirect effects (mediated relationships)	Indirect effects	Bias-Corrected 95% CI		p
		Lower 2.5%	Upper 2.5%	
WFEM → KNOWL → COMP	0.115	0.013	0.296	0.020*
WFEM → MOTIV → COMP	0.081	0.002	0.215	0.041*
MFEM → KNOWL → COMP	0.149	0.016	0.351	0.019*
MFEM → MOTIV → COMP	0.126	0.005	0.305	0.036*
OFEM → KNOWL → COMP	0.118	0.010	0.300	0.030*
OFEM → MOTIV → COMP	0.078	-0.004	0.208	0.068
WFEM → KNOWL → PART	0.111	0.012	0.300	0.025*
WFEM → MOTIV → PART	0.094	0.002	0.276	0.045*
MFEM → KNOWL → PART	0.144	0.014	0.420	0.033*
MFEM → MOTIV → PART	0.146	0.015	0.411	0.021*
OFEM → KNOWL → PART	0.114	0.010	0.322	0.033*
OFEM → MOTIV → PART	0.091	-0.001	0.307	0.054

Note: *$p < 0.05$.

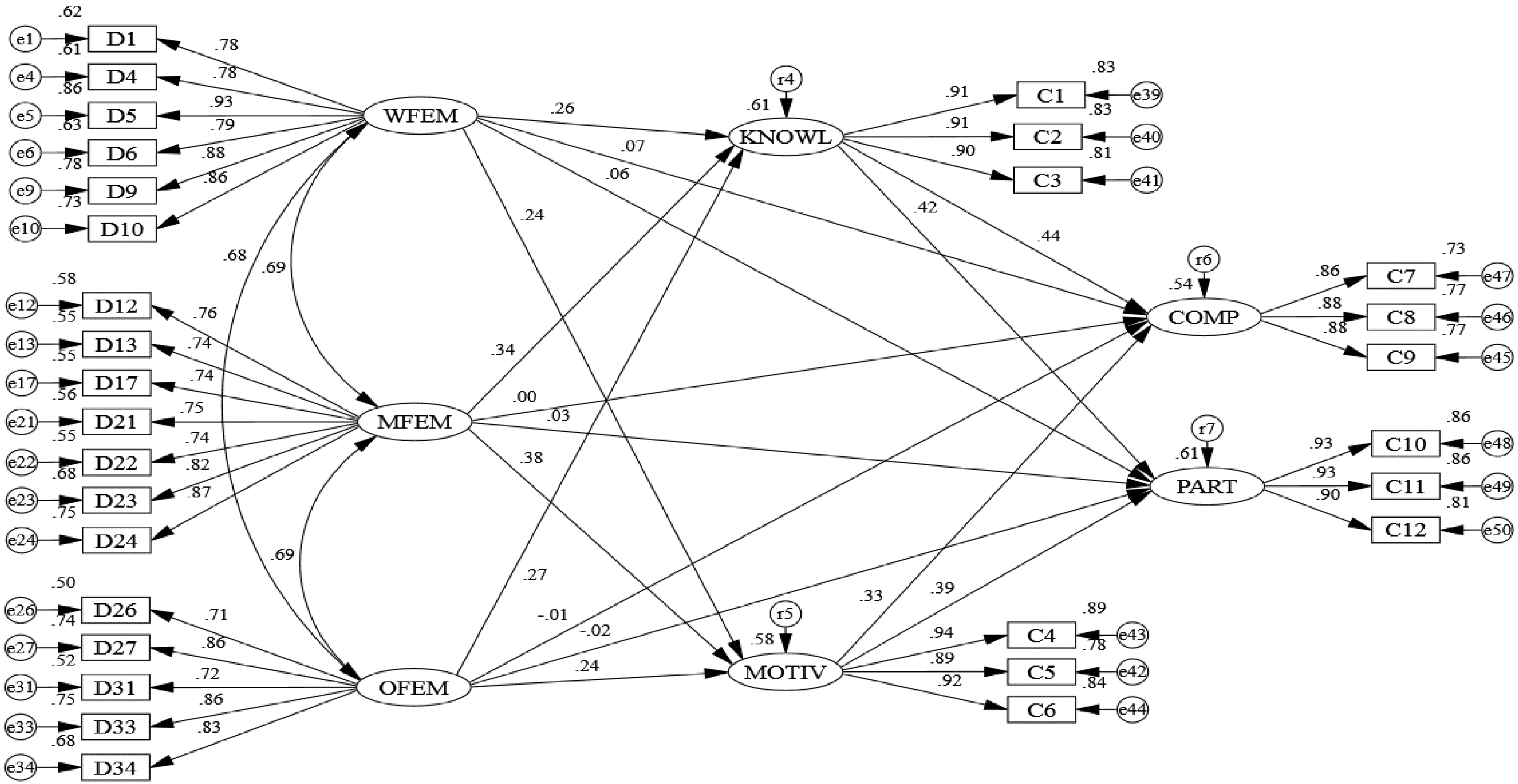

Figure 5.7 Model 3 with standardised path coefficients

Note: Path estimate are standardised coefficients; R^2 = Squared multiple correlations; Two-tailed test.

Hypothesis H_{5a} was supported: The indirect effect of WFEM on the COMP of EMs was significant ($p < 0.05$) (see Table 5.18). The standardised indirect effect of WFEM on COMP was 0.197. WFEM had a significantly positive effect on KNOWL (β = 0.264, t = 2.551, $p < 0.01$) and MOTIV (β = 0.243, t = 2.328, $p < 0.05$), and KNOWL (β = 0.437, t = 3.324, $p < 0.001$) and MOTIV (β = 0.334, t = 2.677, $p < 0.01$) had a significantly positive influence on the COMP of EMs (see Table 5.17).

The direct effect of WFEM on COMP of EMs was significant (β = 0.263, t = 2.114, $p < 0.05$) in Model 1, but was non-significant ($p > 0.05$) after entering the two mediators (i.e., KNOWL and MOTIV) into Model 3, indicating that KNOWL and MOTIV completely mediated the relationship between WFEM and COMP. The indirect effect of WFEM on COMP via KNOWL and MOTIV was 0.115 and 0.081, respectively (see Table 5.19).

Hypothesis H_{5b} was supported: The indirect effect of MFEM on the COMP of EMs was significant ($p < 0.05$) (see Table 5.18). The standardised indirect effect of WFEM on COMP was 0.275. MFEM had a significantly positive effect on KNOWL (β = 0.342, t = 3.123, $p < 0.01$) and MOTIV (β = 0.376, t = 3.394, $p < 0.001$), and KNOWL (β = 0.437, t = 3.324, $p < 0.001$) and MOTIV (β = 0.334, t = 2.677, $p < 0.01$) had a significantly positive influence on the COMP of EMs (see Table 5.17).

The direct effect of MFEM on COMP of EMs was significant (β = 0.270, t = 2.072, $p < 0.05$) in Model 1, but was non-significant ($p > 0.05$) after entering KNOWL and MOTIV into Model 3, indicating that KNOWL and MOTIV completely mediated the relationship between MFEM and COMP of EMs. The indirect effect of MF on COMP via KNOWL and MOTIV was 0.149 and 0.126, respectively (see Table 5.19).

Hypothesis H_{5c} was supported: The indirect effect of OFEM on the COMP of EMs was significant ($p < 0.05$) (see Table 5.18). The direct effect of OFEM on COMP of EMs was not significant in Model 1 and Model 3, indicating that OF only had an indirect effect on the COMP of EMs. The standardised indirect effect of OFEM on COMP was 0.197. OFEM had a significantly positive effect on KNOWL (β = 0.270, t = 2.486, $p < 0.05$) and MOTIV (β = 0.235, t = 2.149, $p < 0.05$), and KNOWL (β = 0.437, t = 3.324, $p < 0.001$) and MOTIV (β = 0.334, t = 2.677, $p < 0.01$) had a significantly positive influence on the COMP of EMs (see Table 5.17). The standardised indirect effect of OFEM on COMP via KNOWL and MOTIV was 0.118 and 0.078, respectively (see Table 5.19).

Hypothesis H_{6a} was supported: The indirect effect of WFEM on the PART of EMs was significant ($p < 0.05$) (see Table 5.18). The standardised indirect effect of WFEM on PART was 0.206. WFEM had a significantly positive effect on KNOWL (β = 0.264, t = 2.551, $p < 0.01$) and MOTIV (β = 0.243, t = 2.328, $p < 0.05$), and KNOWL (β = 0.387, t = 3.476, $p < 0.001$) and MOTIV (β = 0.422, t = 3.545, $p < 0.01$) had a significantly positive influence on the PART of EMs (see Table 5.17).

The direct effect of WFEM on PART of local workers was significant (β = 0.265, t = 2.280, $p < 0.05$) in Model 1, but was non-significant ($p > 0.05$) after entering the two mediators (i.e., KNOWL and MOTIV) into Model 3, indicating that KNOWL and MOTIV completely mediated the relationship between MF and PART. The indirect effect of WFEM on PART via KNOWL and MOTIV was 0.111 and 0.094, respectively (see Table 5.19).

Hypothesis H_{6b} was supported: The indirect effect of MFEM on the PART of EMs was significant ($p < 0.05$) (see Table 5.18). The standardised indirect effect of MFEM on the PART was 0.290. MFEM had a significantly positive effect on KNOWL (β = 0.342, t = 3.123, $p < 0.01$) and MOTIV (β = 0.376, t = 3.394, $p < 0.001$), and KNOWL (β = 0.387, t = 3.476, $p < 0.001$) and MOTIV (β = 0.422, t = 3.545, $p < 0.01$) had a significantly positive influence on the PART of EMs (see Table 5.17).

The direct effect of MFEM on the PART of local workers was significant (β = 0.307, t = 2.509, $p < 0.05$) in Model 1, but was non-significant ($p > 0.05$) after entering the two mediators (i.e., KNOWL and MOTIV) into Model 3, indicating that KNOWL and MOTIV completely mediated the relationship between MFEM and PART. The indirect effect of MFEM on PART via KNOWL and MOTIV was 0.144 and 0.146, respectively (see Table 5.19).

Hypothesis H_{6c} was supported: The indirect effect of OFEM on the PART of EMs was significant ($p < 0.05$) (see Table 5.18). The direct effect of OFEM on PART of EMs was not significant in Model 1 and Model 3, indicating that OFEM only had an indirect effect on the PART of EMs. The standardised indirect effect of OFEM on PART was 0.205. OFEM had a significantly positive effect on KNOWL (β = 0.270, t

= 2.486, $p < 0.05$) and MOTIV ($\beta = 0.235$, $t = 2.149$, $p < 0.05$), and KNOWL ($\beta = 0.387$, $t = 3.476$, $p < 0.001$) and MOTIV ($\beta = 0.422$, $t = 3.545$, $p < 0.01$) had a significantly positive influence on PART of EMs (see Table 5.17). The standardised indirect effect of OFEM on PART via KNOWL and MOTIV was 0.114 and 0.091, respectively (see Table 5.19).

5.10 IMPORTANCE-EXPLANATION ANALYSIS

The mean scores and factor loadings were both taken into consideration to determine the relative importance and explanation power of each factor in the three groups, respectively (i.e., WFEM, MFEM, and OFEM). Figures 5.8-5.10 show the diagrams of importance-explanation analysis for simultaneous comparison of mean scores and factor loadings in groups WFEM, MFEM, and OFEM, respectively.

As shown in Figure 5.8, in the first group, WFEM, the factor loadings of D1, D4, D5, D6, D9, and D10 ranged from 0.779 to 0.924 and mean scores ranged from 3.96 to 4.13 for factors in WFEM. The SC factor D5 "Adequacy of language ability of workers" fell into Quadrant I, indicating that it had the highest importance and explanation power in this group.

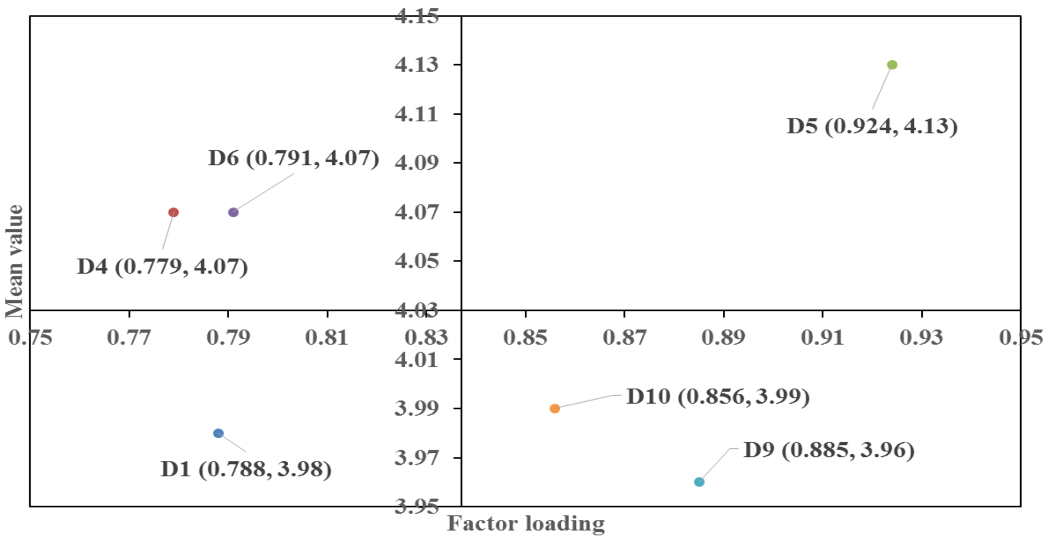

Figure 5.8 Importance-explanation analysis diagram of WFEM

Note: The horizontal axis reflects the standardised factor loading the coffecients (β) of SC factors, while the vertical axis represents the mean values (M) of SC factors.

In the second group, MFEM, the factor loadings of D12, D13, D17, D21, D22, D14, and D24 ranged from 0.744 to 0.860 and mean scores ranged from 3.90 to 4.04 (see Figure 5.9). The SC factor D24 "High quality of supervisor-subordinate relationship" fell into Quadrant I and was identified as the most important and explanatory in the group of MFEM.

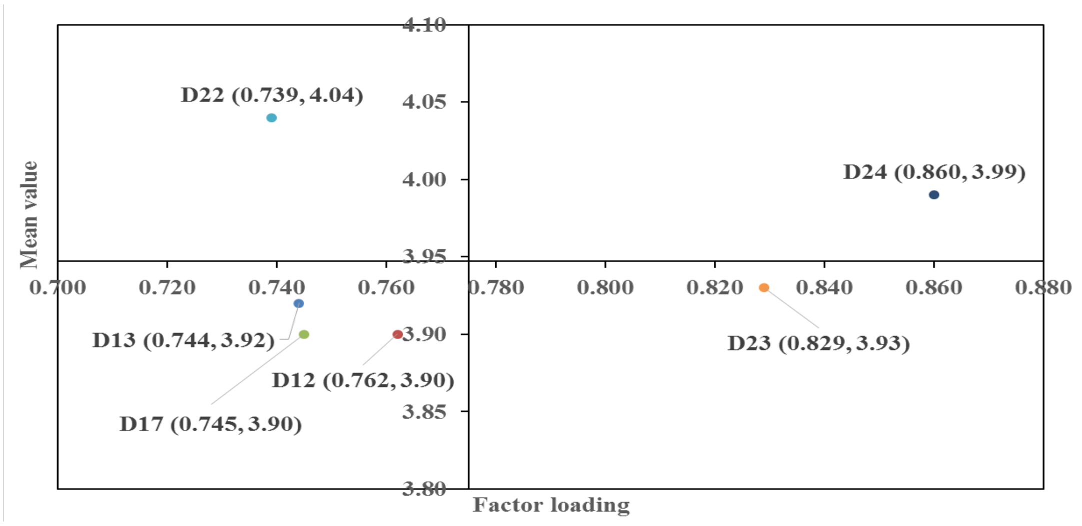

Figure 5.9 Importance-explanation analysis diagram of MFEM

Note: The horizontal axis reflects the standardised factor loading coffecients (*β*) of SC factors, while the vertical axis represents the mean values (*M*) of SC factors.

In the third group, OFEM, the factor loadings of D26, D27, D31, D33, and D34 ranged from 0.717 to 0.858 and mean scores ranged from 3.80 to 3.93, as shown in Figure 5.10. Three factors fell into Quadrant I and were considered the most important and explanatory in the OFEM group, including D34 "No much time pressure for completion of the project", D33 "Organisational support and concern", and D27 "Application of pictorial or visual safety materials".

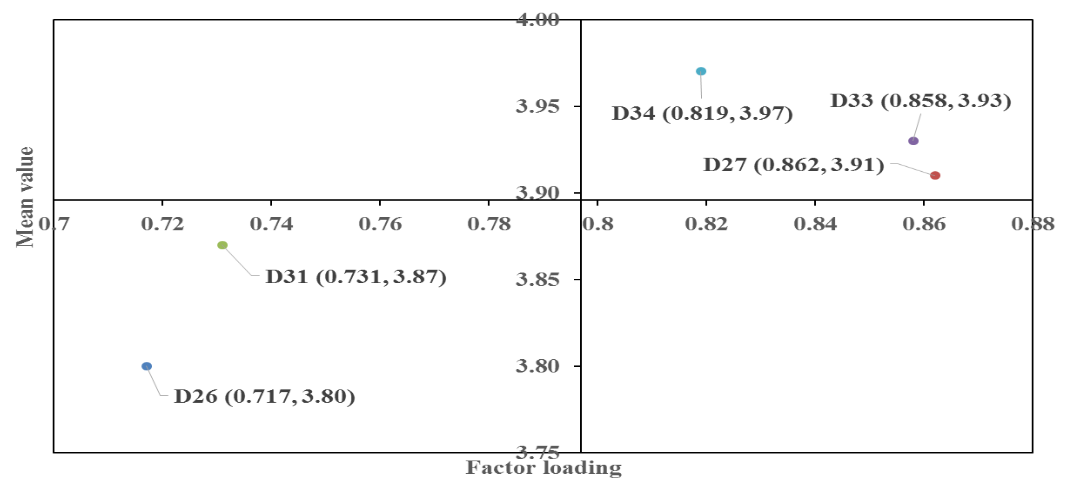

Figure 5.10 Importance-explanation analysis diagram of OFEM

Note: The horizontal axis reflects the standardised factor loading coffecients (β) of SC factors, while the vertical axis represents the mean values (M) of SC factors.

5.11 CHAPTER SUMMARY

This chapter presented the data analysis results and research findings to achieve Objective 2 and 3. Based on data collected from EM respondents in questionnaire survey 1, the mean scores of the safety communication factors were calculated and 18 critical safety communication factors were identified. These 18 critical SC factors for EMs were categorised into three main groups by EFA, namely “Worker-related SC factors of EMs” (WFEM), “Management staff-related SC factors of EMs” (MFEM), and “Organisation-related SC factors of EMs” (OFEM).

The relationships between the critical SC factors and the safety performance of EMs were evaluated using structural equation modelling. WFEM and MFEM had significantly positive direct and indirect effects on the safety compliance of EMs. Safety knowledge and safety motivation were two complete mediators between WFEM and safety compliance. The positive indirect effects of MFEM on safety compliance via safety knowledge and safety motivation were also found to be significant, and safety knowledge and safety motivation completely mediated the relationship between MFEM and the safety compliance of EMs. OFEM only had an indirect effect on the safety compliance of EMs instead of a direct effect.

As for the safety participation of EMs, WFEM factors had both direct and indirect effects on the safety participation of EMs. Safety knowledge and safety motivation completely mediated the relationship between WFEM and the safety participation of

EMs. MFEM also had both direct and indirect effects on the safety participation of EMs and safety knowledge and safety motivation were two complete mediators. OFEM only had an indirect positive effect on the safety participation of EMs via safety knowledge and safety motivation.

Chapter 6: Comparative Analysis of Safety Communication Factors among EMs, Management, and Local Workers

6.1 INTRODUCTION

This chapter presents the research findings of Objective 4. The critical safety communication factors of EMs perceived by management staff are identified. The ranking difference in safety communication factors of EMs between management and EMs is analysed. In addition, critical safety communication factors for local workers are also identified. The ranking difference in safety communication factors between local workers and EMs is revealed. The relationships between safety communication factors and the safety performance of local workers are also established.

6.2 COMPARATIVE ANALYSIS BETWEEN EMS AND MANAGEMENT

6.2.1 Descriptive analysis of management

As for the questionnaire for management in survey 1, a total of 95 valid questionnaires were collected from management staff. Among them, approximately 78.9% of valid questionnaires (N = 75) were collected from Hong Kong and 21.1% of valid questionnaires (N = 20) were collected from Australia (see Table 6.1). The positions of management respondents included project manager, safety manager, safety officer, engineer, foreman, and safety supervisor. The majority of management staff had been engaged in the construction industry for more than one year. Some management staff did not have work experience with EMs (15 out of a total of 95). However, the majority of management staff (approximately 84.2%) had work experience with EM construction workers. Therefore, the information related to the safety communication factors of EMs provided by management staff was deemed to be reliable and representative.

Table 6.1 Profile of management staff

Categories	Groups	Number	Percentage
Location	Hong Kong	75	78.9
	Australia	20	21.1
Employer	Main contractor	83	87.4
	Subcontractor	12	12.6
Work experience in the construction industry	< 1 years	5	5.3
	1–5 years	27	28.4
	6–10 years	16	16.8
	11–15 years	9	9.5
	> 16 years	38	40.0
Work experience with EM construction workers	0 year	15	15.8
	< 1 year	16	16.8
	1–5 years	32	33.7
	6–10 years	12	12.6
	11–15 years	4	4.2
	> 16 years	16	16.8

6.2.2 Critical SC factors of EMs perceived by management

In order to capture the perceptions of management staff regarding the safety communication factors of EMs, the 36 safety communication factors scale used by EMs was also evaluated by management staff.

6.2.2.1 Overall management staff perceptions concerning SC factors of EMs

Table 6.2 lists the overall management staff responses to the ranking of SC factors of EMs in descending order of significance. The mean scores for SC factors of EMs rated by all management staff ranged from 3.14 to 3.72. The normalised values of mean scores for each variable were calculated to determine the critical SC factors. As shown in Table 6.2, a total of 17 SC factors with normalised values equal or higher than 0.50 indicated that management staff perceived that these 17 SC factors were critical SC factors for EMs. As perceived by management staff, the top four critical factors for EMs were "Adequacy of language ability of workers" (D5), "Adequacy of time when communicating with workers" (D19), "Appropriateness of communication style of management" (D12), and "Appropriateness of communication channel adopted to convey safety information" (D25). The three SC factors for EMs that were ranked as least significant by all management staff included "Degree of power or status differences between construction workers and their management staff" (D14), "Cultural sensitivity and competence of management" (D23), and "Appropriateness of the amount of safety information presented at one time by management" (D15).

Table 6.2 Overall management's responses to ranking of SC factors of EMs

Code	Number of respondents scoring					Mean	Normalised value	Rank
	1	2	3	4	5			
D5	**3**	**12**	**18**	**38**	**24**	**3.72**	**0.99**	**1**
D19	**0**	**9**	**27**	**42**	**17**	**3.71**	**0.97**	**2**
D12	**0**	**6**	**30**	**46**	**13**	**3.69**	**0.96**	**3**
D25	**1**	**6**	**32**	**38**	**18**	**3.69**	**0.96**	**4**
D11	**2**	**9**	**27**	**37**	**20**	**3.67**	**0.92**	**5**
D31	**1**	**11**	**22**	**46**	**15**	**3.66**	**0.90**	**6**
D32	**2**	**10**	**26**	**38**	**19**	**3.65**	**0.88**	**7**
D35	**1**	**6**	**34**	**38**	**16**	**3.65**	**0.88**	**8**
D4	**3**	**15**	**18**	**36**	**23**	**3.64**	**0.87**	**9**
D18	**0**	**10**	**30**	**41**	**14**	**3.62**	**0.83**	**10**
D27	**2**	**10**	**28**	**38**	**17**	**3.61**	**0.81**	**11**
D17	**2**	**11**	**23**	**47**	**12**	**3.59**	**0.77**	**12**
D34	**3**	**12**	**27**	**32**	**21**	**3.59**	**0.77**	**13**
D21	**2**	**12**	**25**	**40**	**16**	**3.59**	**0.77**	**14**
D24	**1**	**13**	**33**	**34**	**14**	**3.49**	**0.61**	**15**
D33	**1**	**15**	**35**	**28**	**16**	**3.45**	**0.54**	**16**
D20	**2**	**11**	**38**	**31**	**13**	**3.44**	**0.52**	**17**
D22	1	14	38	28	14	3.42	0.48	18
D6	3	11	35	35	11	3.42	0.48	19
D36	3	14	35	27	16	3.41	0.47	20
D28	5	11	37	24	18	3.41	0.47	21
D26	3	13	39	23	17	3.40	0.45	22
D29	3	13	33	36	10	3.39	0.43	23
D13	2	16	34	32	11	3.36	0.38	24
D3	5	11	36	33	10	3.34	0.34	25
D16	2	14	40	28	11	3.34	0.34	26
D10	3	15	32	38	7	3.33	0.32	27
D1	4	14	36	32	9	3.29	0.27	28
D9	4	15	38	26	12	3.28	0.25	29
D2	4	14	43	20	14	3.27	0.23	30
D8	3	24	33	16	19	3.25	0.19	31
D7	3	18	38	26	10	3.23	0.16	32
D30	0	21	40	26	8	3.22	0.14	33
D14	2	15	45	26	7	3.22	0.14	34
D23	2	16	47	20	10	3.21	0.12	35
D15	4	20	41	19	11	3.14	0.00	36

Note: Normalised value = (mean − minimum mean)/(maximum mean − minimum mean); the critical SC factors for EMs perceived by management staff are highlighted in bold.

6.2.2.2 Perceptions of different groups of management concerning the SC factors of EMs

Management staff were divided into different groups based on the nature of the respondents. In terms of types of employer, management staff were classified into a main contractor group and a subcontractor group. Management were classified into a Hong Kong group and an Australia group according to the location of respondents. The management staff who did not have work experience with EMs were classified as non-experienced, while management staff who had work experience with EMs were classified as experienced. The SC factors of EMs were assessed from the perspectives of different groups of management staff as follows:

- Descriptive statistics were adopted to calculate the mean values and rank of each group of management staff.
- Kendall's concordance analysis was carried out to test the agreement within each group of management staff.
- Spearman's rank correlation test was conducted to analyse the correlation of ranks between two groups of management staff.

Figure 6.1 shows the distribution profiles of the mean scores of the 36 SC factors of EMs considered by different groups. The mean values and ranks of 36 SC factors for EMs by all management groups are reported in Table 6.3. The results of Kendall's concordance analysis are also presented in Table 6.3. The Kendall's coefficient of concordance W for the rankings of SC factors of EMs was 0.046, 0.047, 0.097, 0.044, 0.166, 0.047, and 0.099 for the overall management staff, main contractor group, subcontractor group, Hong Kong group, Australia group, experienced group, and non-experienced group, respectively. As the number of objects was higher than seven, the value of chi-square χ^2 instead of W was adopted to assess the agreement within each group. The critical chi-square χ^2 value for p = 0.05 (95% confidence level) with 35 degree of freedom was 49.802. The values of actual chi-square χ^2 for the main contractor group, subcontractor group, Hong Kong group, Australia group, and experienced group (151.878, 119.035, 78.167, 114.401, 116.519, 132.523, and 51.867, respectively), were all higher than the value of critical chi-square χ^2. Thus, the null hypothesis: "There is no significant agreement among respondents in the ranking of different SC factors of EMs within each group" was rejected. This indicated that the significant agreement among management respondents in rankings of SC factors for EMs within each group was achieved.

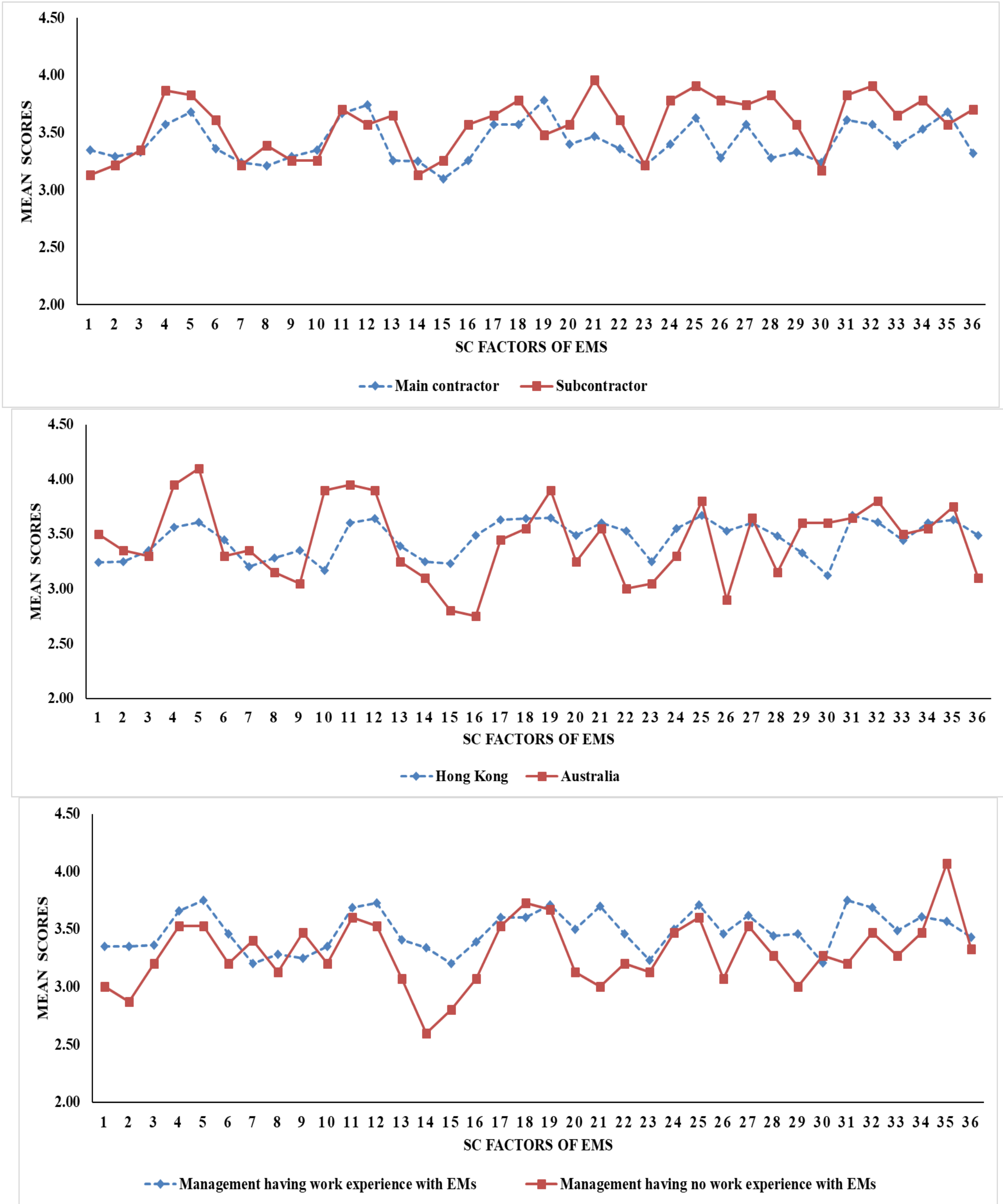

Figure 6.1 Cross-comparison of SC factors among different groups of management

Table 6.3 Ranking and results of Kendall's concordance analysis by different groups of management

SC factors	All management		Main contactor		Subcontractor		Hong Kong		Australia		Experienced group		Non-experienced group	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
D1	3.29	28	3.35	21	3.13	35	3.24	32	3.50	18	3.35	28	3.00	33
D2	3.27	30	3.29	26	3.22	31	3.25	29	3.35	20	3.35	29	2.87	34
D3	3.34	25	3.33	23	3.35	27	3.35	25	3.30	24	3.36	26	3.20	23
D4	3.64	9	3.57	9	3.87	4	3.56	14	3.95	3	3.66	9	3.53	8
D5	3.72	1	3.68	3	3.83	5	3.61	9	4.10	1	3.75	1	3.53	6
D6	3.42	18	3.36	18	3.61	18	3.45	22	3.30	23	3.46	19	3.20	21
D7	3.23	32	3.24	32	3.22	32	3.20	34	3.35	21	3.20	35	3.40	15
D8	3.25	31	3.21	34	3.39	26	3.28	28	3.15	28	3.28	31	3.13	26
D9	3.28	29	3.29	25	3.26	29	3.35	26	3.05	31	3.25	32	3.47	14
D10	3.33	27	3.35	20	3.26	28	3.17	35	3.90	6	3.35	27	3.20	24
D11	3.67	5	3.67	5	3.70	13	3.60	13	3.95	2	3.69	7	3.60	5
D12	3.69	3	3.74	2	3.57	20	3.64	5	3.90	5	3.73	3	3.53	7
D13	3.36	24	3.26	29	3.65	17	3.39	24	3.25	26	3.41	24	3.07	29
D14	3.22	33	3.25	31	3.13	36	3.25	31	3.10	30	3.34	30	2.60	36
D15	3.14	36	3.10	36	3.26	30	3.23	33	2.80	35	3.20	36	2.80	35
D16	3.34	26	3.26	30	3.57	24	3.49	20	2.75	36	3.39	25	3.07	30
D17	3.59	12	3.57	12	3.65	15	3.63	6	3.45	19	3.60	13	3.53	10
D18	3.62	10	3.57	10	3.78	8	3.64	4	3.55	14	3.60	12	3.73	2
D19	3.71	2	3.78	1	3.48	25	3.65	3	3.90	4	3.71	4	3.67	3

D20	3.44	17	3.40	16	3.57	22	3.49	19	3.25	25	3.50	16	3.13	25
D21	3.59	13	3.47	14	3.96	1	3.60	10	3.55	15	3.70	6	3.00	31
D22	3.42	19	3.36	19	3.61	19	3.53	17	3.00	33	3.46	20	3.20	22
D23	3.21	35	3.21	35	3.22	33	3.25	30	3.05	32	3.23	33	3.13	27
D24	3.49	15	3.40	15	3.78	10	3.55	15	3.30	22	3.50	15	3.47	13
D25	3.69	4	3.63	6	3.91	2	3.67	1	3.80	7	3.71	5	3.60	4
D26	3.40	22	3.28	28	3.78	11	3.53	16	2.90	34	3.46	21	3.07	28
D27	3.61	11	3.57	11	3.74	12	3.60	12	3.65	11	3.62	10	3.53	9
D28	3.41	20	3.28	27	3.83	7	3.48	21	3.15	27	3.44	22	3.27	18
D29	3.39	23	3.33	22	3.57	23	3.33	27	3.60	12	3.46	18	3.00	32
D30	3.22	34	3.24	33	3.17	34	3.12	36	3.60	13	3.21	34	3.27	19
D31	3.66	6	3.61	7	3.83	6	3.67	2	3.65	10	3.75	2	3.20	20
D32	3.65	7	3.57	8	3.91	3	3.61	8	3.80	8	3.69	8	3.47	11
D33	3.45	16	3.39	17	3.65	16	3.44	23	3.50	17	3.49	17	3.27	17
D34	3.59	14	3.53	13	3.78	9	3.60	11	3.55	16	3.61	11	3.47	12
D35	3.65	8	3.68	4	3.57	21	3.63	7	3.75	9	3.57	14	4.07	1
D36	3.41	21	3.32	24	3.70	14	3.49	18	3.10	29	3.43	23	3.33	16
N	95		72		23		75		20		80		15	
W	0.046		0.047		0.097		0.044		0.166		0.047		0.099	
Actual χ^2	151.878		119.035		78.167		114.401		116.519		132.523		51.867	
Critical χ^2	49.802		49.802		49.802		49.802		49.802		49.802		49.802	
df	35		35		35		35		35		35		35	
p	0.000		0.000		0.000		0.000		0.000		0.000		0.000	

Note: *N* = Number; *W* = Kendall's coefficient of concordance; *df* = Degree of freedom; H_0 = There is no significant agreement among respondents in the ranking of different SC factors of EMs within each group.

Having tested the internal consistency within each management group, the level of agreement or disagreement in the rankings between groups was tested. To evaluate the level of agreement between two management groups in their rankings of SC factors for EMs, the ranks derived from each management group were imported to calculate the Spearman rank correlation (r_s). The values of Spearman rank correlation r_s and the corresponding significance levels are shown in Table 6.4. The null hypothesis was rejected at a 1% significance level. Thus, it indicated that a considerable agreement existed between any two groups of management in the rankings of SC factors of EMs.

Table 6.4 Spearman rank correlation test between two groups of management on SC factors of EMs

Comparison	r_s	Significance	Conclusion
Main Contractor vs Subcontractor	0.614	0.000	Reject H_0
Hong Kong vs Australia	0.495	0.000	Reject H_0
Experienced vs Non-experienced	0.633	0.000	Reject H_0

Note: H_0 = There is no association on rankings of SC factors of EMs between two groups; Two-tailed test.

6.2.3 Ranking difference of SC factors between management and EMs

In order to compare the rankings of SC factors of EMs between management and EM respondents, the following stages of analysis were carried out:

- Spearman rank correlation test was used to test whether a significant correlation existed between the rankings of 36 SC factors for EMs.
- The *t*-test was used to assess if any significant difference existed between the mean value of each SC factor between management and EMs.

Figure 6.2 shows the distribution profiles of the mean scores of the 36 SC factors of EMs considered by EMs and management. The results of Spearman rank correlation are presented in Table 6.5. The value of r_s of rankings between EMs group and management group on the SC factors for EMs was 0.194, with a *p*-value of 0.257 greater than 0.05. Thus, the null hypothesis was not rejected, indicating that no significant correlation existed between EMs group and management group on the rankings of SC factors of EMs.

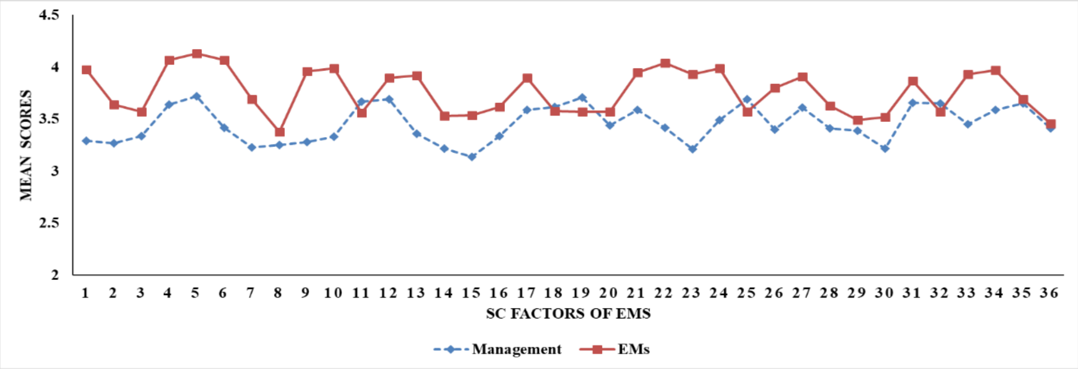

Figure 6.2 Cross-comparison of SC factors of EMs between management and EMs

Table 6.5 Spearman rank correlation test between EMs and management on SC factors of EMs

Comparison	r_s	p	Conclusion
EMs vs Management	0.194	0.257	Accept H_0

H_0 = There is no significant correlation on the rankings of SC factors of EMs between EMs and management staff.

Ha = There is significant correlation on the rankings of SC factors of EMs between EMs and management staff.

Note: Two-tailed test.

Table 6.6 shows the mean and rank of SC factors of EMs perceived by management staff and EM construction workers, *t*-value, and *p*-value derived from *t*-test. A total of 22 SC factors with a *p*-value were smaller than the pre-determined significance level of 0.05, while the others had a *p*-value higher than 0.05. It can be concluded from the results that the mean values of D1 ($t = 5.645$, $p = 0.000$), D2 ($t = 2.455$, $p = 0.015$), D4 ($t = 3.145$, $p = 0.002$), D5 ($t = 3.112$, $p = 0.002$), D6 ($t = 5.160$, $p = 0.000$), D7 ($t = 3.301$, $p = 0.001$), D9 ($t = 5.403$, $p = 0.000$), D10 ($t = 5.329$, $p = 0.000$), D13 ($t = 4.614$, $p = 0.000$), D14 ($t = 2.365$, $p = 0.019$), D15 ($t = 2.745$, $p = 0.007$), D16 ($t = 1.983$, $p = 0.049$), D17 ($t = 2.649$, $p = 0.009$), D21 ($t = 2.965$, $p = 0.003$), D22 ($t = 5.128$, $p = 0.000$), D23 ($t = 6.176$, $p = 0.000$), D24 ($t = 4.051$, $p = 0.000$), D26 ($t = 2.975$, $p = 0.003$), D27 ($t = 2.274$, $p = 0.024$), D30 ($t = 2.208$, $p = 0.028$), D33 ($t = 3.372$, $p = 0.001$), and D34 ($t = 2.711$, $p = 0.007$) in the EMs group were significantly greater than those in the management group.

Table 6.6 Ranking of SC factors for EMs and *t*-test results

Code	EMs		Management		*t*	*p*	Mean difference
	Mean	Rank	Mean	Rank			
D1	3.98	**7**	3.29	28	5.645	0.000***	0.683
D2	3.64	21	3.27	30	2.455	0.015*	0.368
D3	3.57	27	3.34	25	1.520	0.130	0.230
<u>D4</u>	4.07	**3**	3.64	**9**	3.145	0.002**	0.425
<u>D5</u>	4.13	**1**	3.72	**1**	3.112	0.002**	0.411
D6	4.07	**2**	3.42	18	5.160	0.000***	0.654
D7	3.69	19	3.23	32	3.301	0.001**	0.462
D8	3.38	36	3.25	31	0.807	0.421	0.128
D9	3.96	**9**	3.28	29	5.403	0.000***	0.678
D10	3.99	**6**	3.33	27	5.329	0.000***	0.659
D11	3.56	30	3.67	**5**	-0.764	0.446	-0.114
<u>D12</u>	3.90	**16**	3.69	**3**	1.850	0.066	0.201
D13	3.92	**13**	3.36	24	4.614	0.000***	0.560
D14	3.53	32	3.22	33	2.365	0.019*	0.309
D15	3.54	31	3.14	36	2.745	0.007**	0.400
D16	3.62	23	3.34	26	1.983	0.049*	0.283
D17	3.90	15	3.59	**12**	2.649	0.009**	0.314
D18	3.58	24	3.62	**10**	-0.273	0.785	-0.039
D19	3.57	29	3.71	**2**	-1.030	0.304	-0.138
D20	3.57	25	3.44	**17**	0.966	0.335	0.133
<u>D21</u>	3.95	**10**	3.59	**13**	2.965	0.003**	0.358
D22	4.04	**4**	3.42	19	5.128	0.000***	0.624
D23	3.93	**12**	3.21	35	6.176	0.000***	0.715
<u>D24</u>	3.99	**5**	3.49	**15**	4.051	0.000***	0.490
D25	3.57	26	3.69	**4**	-0.901	0.369	-0.120
D26	3.80	18	3.40	22	2.975	0.003**	0.399
D27	3.91	14	3.61	**11**	2.274	0.024*	0.300
D28	3.63	22	3.41	20	1.478	0.141	0.216
D29	3.49	34	3.39	23	0.676	0.499	0.096
D30	3.52	33	3.22	34	2.208	0.028*	0.301
<u>D31</u>	3.87	**17**	3.66	**6**	1.620	0.107	0.210
D32	3.57	28	3.65	**7**	-0.571	0.569	-0.085
<u>D33</u>	3.93	**11**	3.45	**16**	3.372	0.001**	0.480
<u>D34</u>	3.97	**8**	3.59	**14**	2.711	0.007**	0.381
D35	3.69	20	3.65	**8**	0.258	0.796	0.034
D36	3.46	35	3.41	21	0.297	0.767	0.045

Note: Two-tailed test; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$; the critical SC factors are highlighted in bold; the SC factors ranked as critical by both EMs and management are marked by underline.

6.3 COMPARATIVE ANALYSIS BETWEEN EMS AND LOCAL WORKERS

6.3.1 Descriptive statistics analysis of local construction workers

A total of 200 and 100 questionnaires were distributed to local workers in Hong Kong and Australia, respectively, with 162 and 66 questionnaires collected. The response rate was 66% and 76%, respectively. After deletion of 17 and nine invalid questionnaires from Hong Kong and Australia, a total of 145 and 57 valid questionnaires remained and the valid response rates were 73% and 57% for local respondents in Hong Kong and Australia. The total number of valid questionnaires from local workers was 202 and the overall valid response rate was 67%. The trades of local workers included labourer, plumber, scaffolder, carpenter, concreter, plasterer, metal worker, bar bender and fixer, and equipment operator. Table 6.7 lists the demographic information of local respondents, including age, employer, education level, work experience in the construction sector, and length of service with the current company.

Table 6.7 Demographic information of local construction workers

Demographic variables		Number	Percentage
Age	20 or below	9	4.5
	21–30	48	23.8
	31–40	51	25.2
	41–50	38	18.8
	51 or above	56	27.8
Educational level	Below primary	18	8.9
	Primary	42	20.8
	Secondary	110	54.5
	Certificate	26	12.9
	Degree or higher	6	3.0
Employer	Contractor	31	15.3
	Subcontractor	171	84.7
Work experience in the construction industry	< 6 years	22	10.9
	6–10 years	58	28.7
	11–15 years	28	13.9
	> 16 years	33	15.0
Length of service with the current company	< 1 year	76	37.6
	1–5 years	45	22.3
	6–10 years	27	13.4
	> 10 years	54	26.7

6.3.2 Critical SC factors for local workers

The mean scores of the SC factors for local construction workers ranged from 2.92 to 3.63, as reported in Table 6.8. A total of 18 critical SC factors for local workers were identified, which had normalised values of the mean scores higher than 0.50. The first three critical SC factors for local workers were "Adequacy and appropriateness of safety trainings" (D31), "Adequacy and appropriateness of toolbox talks" (D32), and "Adequacy and appropriateness of formal presentation from upper management" (D29). The local construction workers perceived that the three least SC factors for them were "Avoiding using too much technical terminology and difficult words by management" (D13), "Adequacy of workers' understanding of culture in host country" (D1), and "Employment of safety staff from workers' origin country" (D26).

Table 6.8 Ranking of SC factors for EMs and local workers and *t*-test results

Code	EMs		Local workers			*t*	*p*	Mean difference
	Mean	Rank	Mean	Normalised value	Rank			
D1	3.98	7	3.03	0.15	35	9.282	0.000***	0.943
D2	3.64	21	**3.38**	**0.65**	**16**	2.156	0.032*	0.266
D3	3.57	27	3.06	0.20	33	3.848	0.000***	0.508
D4	4.07	3	**3.54**	**0.87**	**5**	5.181	0.000***	0.523
D5	4.13	1	3.21	0.41	24	9.146	0.000***	0.914
D6	4.07	2	**3.46**	**0.76**	**12**	6.138	0.000***	0.614
D7	3.69	19	3.11	0.27	31	4.808	0.000***	0.585
D8	3.38	36	3.07	0.21	32	2.320	0.021*	0.311
D9	3.96	9	**3.43**	**0.72**	**14**	5.548	0.000***	0.532
D10	3.99	6	**3.43**	**0.72**	**15**	5.539	0.000***	0.554
D11	3.56	30	3.13	0.30	30	3.339	0.001**	0.431
D12	3.90	16	3.23	0.44	21	6.454	0.000***	0.663
D13	3.92	13	3.05	0.18	34	8.581	0.000***	0.868
D14	3.53	32	3.17	0.35	28	3.053	0.003**	0.357
D15	3.54	31	3.16	0.34	29	3.119	0.002**	0.374
D16	3.62	23	**3.44**	**0.73**	**13**	1.488	0.138	0.184
D17	3.90	15	**3.54**	**0.87**	**6**	3.812	0.000***	0.358
D18	3.58	24	3.22	0.42	23	2.801	0.006**	0.359
D19	3.57	29	**3.28**	**0.51**	**18**	2.366	0.019*	0.290
D20	3.57	25	**3.36**	**0.62**	**17**	1.858	0.064	0.213

D21	3.95	10	**3.53**	**0.86**	**8**	4.572	0.000***	0.418
D22	4.04	4	**3.54**	**0.87**	**7**	5.183	0.000***	0.505
D23	3.93	12	3.19	0.38	26	7.678	0.000***	0.737
D24	3.99	5	3.19	0.38	27	7.666	0.000***	0.797
D25	3.57	26	**3.51**	**0.83**	**9**	0.527	0.599	0.060
D26	3.80	18	2.92	0.00	36	8.239	0.000***	0.878
D27	3.91	14	3.25	0.46	19	6.036	0.000***	0.663
D28	3.63	22	3.19	0.38	25	3.839	0.000***	0.434
D29	3.49	34	**3.58**	**0.93**	**3**	-0.864	0.388	-0.099
D30	3.52	33	**3.48**	**0.79**	**11**	0.352	0.725	0.042
D31	3.87	17	**3.63**	**1.00**	**1**	2.308	0.022*	0.239
D32	3.57	28	**3.60**	**0.96**	**2**	-0.292	0.771	-0.037
D33	3.93	11	**3.55**	**0.89**	**4**	3.436	0.001**	0.378
D34	3.97	8	3.24	0.45	20	6.955	0.000***	0.728
D35	3.69	20	**3.51**	**0.83**	**10**	1.564	0.119	0.177
D36	3.46	35	3.22	0.42	22	1.830	0.069	0.232

Note: Normalised value = (mean − minimum mean)/(maximum mean − minimum mean); Two-tailed test; $*p < 0.05$, $**p < 0.01$, $***p < 0.001$; the critical SC factors for local workers are highlighted in bold.

6.3.3 Ranking difference of SC factors between EMs and local workers

To investigate the differences in rankings of the SC factors perceived by EMs and local workers, the following stages of analysis were carried out:

- Spearman rank correlation test was firstly applied to examine the correlation on the rankings.
- A *t*-test was used to test if any significant difference existed in each SC factor between EMs and local workers.

Figure 6.3 shows the distribution profiles of the mean scores of the 36 SC factors considered by EMs and local construction workers. The results of the Spearman rank correlation are presented in Table 6.9. The results of *t*-test are shown in Table 6.8.

The value of r_S of rankings between EMs group and local worker group on the SC factors was 0.128, with a *p*-value of 0.457 higher than 0.05. Thus, the null hypothesis was not rejected, indicating that no significant correlation existed between EMs group and local worker group on the rankings of SC factors.

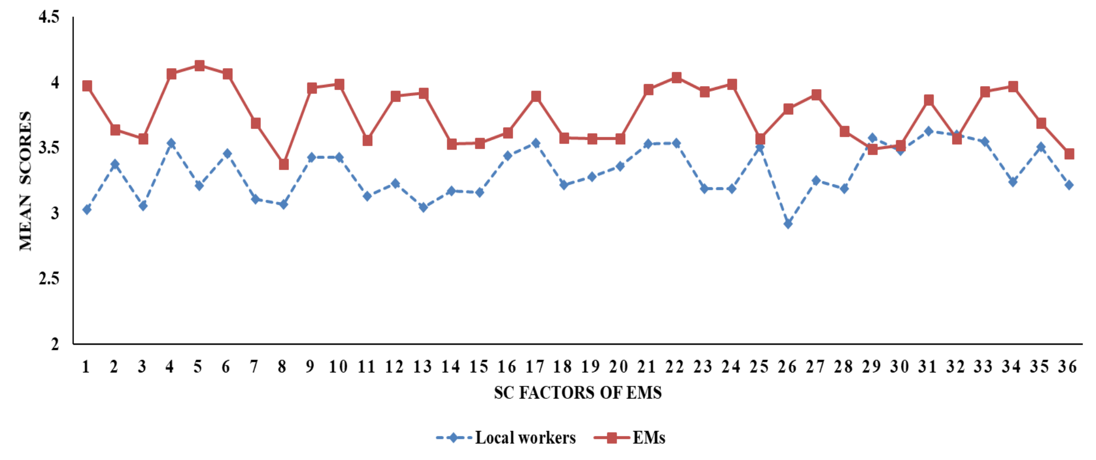

Figure 6.3 Cross-comparison of SC factors between EMs and local workers

Table 6.9 Spearman rank correlation test between EMs and local workers on SC factors

Comparison	r_s	p	Conclusion
EMs vs local workers	0.128	0.457	Accept H_0

H_0 = There is no significant correlation on the rankings of SC factors between EMs and local workers.

Ha = There is significant correlation on the rankings of SC factors between EMs and local workers.

Note: Two-tailed test.

Differences in the means of each SC factor between EM group and local group were examined by *t*-test. The results of *t*-test (see Table 6.8) indicated that the perceptions of D1 (t = 9.282, p = 0.000), D2 (t = 2.156, p = 0.032), D3 (t = 3.848, p = 0.000), D4 (t = 5.181, p = 0.000), D5 (t = 9.146, p = 0.000), D6 (t = 6.138, p = 0.000), D7 (t = 4.808, p = 0.000), D8 (t = 2.320, p = 0.021), D9 (t = 5.548, p = 0.000), D10 (t = 5.539, p = 0.000), D11 (t = 3.339, p = 0.001), D12 (t = 6.454, p = 0.000), D13 (t = 8.581, p = 0.000), D14 (t =3.053, p = 0.003), D15 (t = 3.119, p = 0.002), D17 (t = 3.812, p = 0.000), D18 (t = 2.801, p = 0.006), D19 (t = 2.366, p = 0.019), D21 (t = 4.572, p = 0.000), D22 (t = 5.183, p = 0.000), D23 (t = 7.678, p = 0.000), D24 (t = 7.666, p = 0.000), D26 (t = 8.239, p = 0.000), D27 (t = 6.036, p = 0.000), D28 (t = 3.839, p = 0.000), D31 (t = 2.308, p = 0.022), D33 (t = 3.436, p = 0.001), and D34 (t = 6.955, p = 0.000) of local workers were all significantly lower than those of EMs.

6.3.4 EFA on critical SC factors for local workers

The 18 critical SC factors were analysed using EFA to determine the underlying structure. The ratio between 202 cases and 18 variables was 11.22, which was greater than 5.00 suggested by Gorsuch (1983), indicating that the sample size was sufficient to conduct EFA. As shown in Table 6.10, the KMO value was 0.905, indicating an excellent sampling adequacy (Kaiser, 1960). The approximation of chi-square in Bartlett's test of sphericity was 2560.267 ($df = 153$, $p < 0.001$), supporting the normal distribution assumption. Hence, the data on safety communication factors collected in this study were suitable to conduct EFA.

Table 6.10 KMO and Bartlett's test result for local workers sample

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.905
	Approx. Chi-Square	2560.267
Bartlett's Test of Sphericity	*df*	153
	Significance	0.000

Note: df = Degree of freedom.

PCA was carried out and the result indicated that three constructs with eigenvalues were higher than 1. Additionally, the scree-plot and results of PA suggested three SC factors to retain (see Figure 6.4 and Table 6.11). Thus, the number of factors to retain was three.

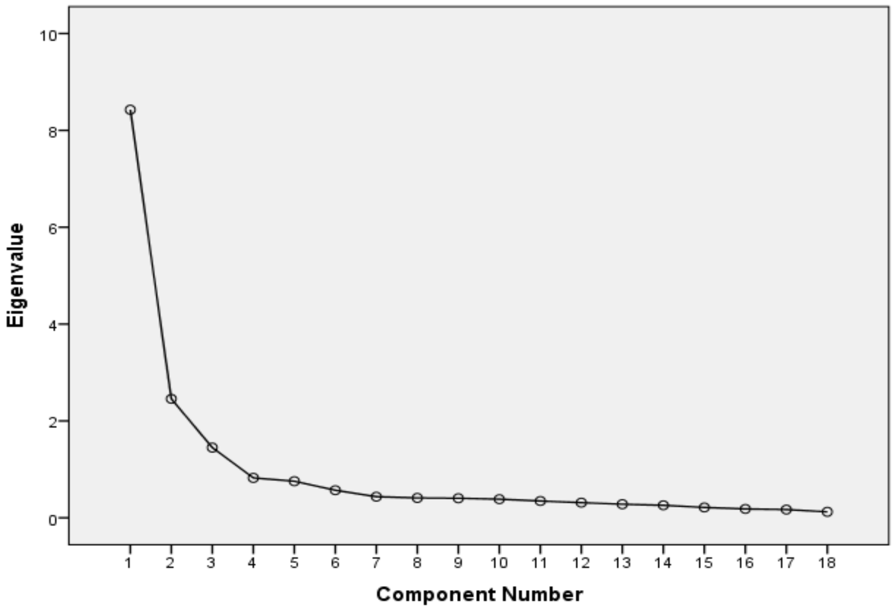

Figure 6.4 Scree plot of EFA on local worker sample

Table 6.11 Result of PA on the local worker sample

Construct number	Actual eigenvalue from PCA	Random order eigenvalue from PA	Decision
1	8.426	1.5672	Accept
2	2.457	1.4492	Accept
3	1.450	1.3620	Accept
4	0.823	1.2877	Reject

As the maximum factor correlation coefficient (0.600) between each construct was greater than 0.32 (see Table 6.12), oblique rotation was applied. Direct oblimin rotation was selected to rotate the factors. The extracted SC factors for local workers with rotated pattern and structure matrix are shown in Table 6.13.

The first SC factor was labelled as "Organisation-related SC factors of local workers" (OFL) and was composed of seven variables. The second SC factor was labelled as "Worker-related SC factors of local workers" (WFL) and consisted of five variables. The third SC factor was labelled as "Management staff-related SC factors of local workers" (MFL) and included six variables. The Cronbach's alpha values for OFL, WFL, and OFL were 0.921, 0.890, and 0.898, as listed in Table 6.12.

Table 6.12 Factor correlation coefficient and Cronbach's alpha

Factors	Variable number	Mean	Cronbach's alpha	Factor correlations		
				OFL	WFL	MFL
OFL	7	3.554	0.921	1.000		
WFL	5	3.483	0.890	0.422	1.000	
MFL	6	3.449	0.898	0.600	0.326	1.000

Note: Extraction method: principal component analysis; rotation method: direct oblimin rotation.

Table 6.13 Rotated factor matrix for PCA of SC factors for local workers.

Variable		Pattern coefficients			Structure coefficients			Communalities
		OFL	WFL	MFL	OFL	WFL	MFL	
Group 1: Organisation-related SC factors of local workers (OFL) (eigenvalue = 1.450, % of variance explained = 46.814, cumulative % = 46.814)								
D25	Appropriateness of communication channel adopted to convey safety information	**0.647**	0.067	0.145	**0.762**	0.387	0.556	0.600
D29	Adequacy and appropriateness of formal presentation from upper management	**0.838**	0.003	-0.048	**0.811**	0.341	0.456	0.659
D30	Adequacy and appropriateness of written communication	**0.843**	0.187	-0.144	**0.836**	0.496	0.423	0.736
D31	Adequacy and appropriateness of safety trainings	**0.878**	-0.048	0.006	**0.861**	0.325	0.518	0.744
D32	Adequacy and appropriateness of toolbox talks	**0.853**	-0.016	0.067	**0.886**	0.366	0.574	0.789
D33	Organisational support and concern	**0.805**	-0.046	0.109	**0.851**	0.329	0.577	0.732
D35	Appropriate composition of construction team members	**0.555**	0.008	0.282	**0.728**	0.334	0.618	0.581
Group 2: Worker-related SC factors of local workers (WFL) (eigenvalue = 8.426; % of variance explained = 13.651, cumulative % = 60.464)								
D2	Sufficient educational level of workers	-0.094	**0.882**	0.068	0.319	**0.865**	0.299	0.753
D4	Having work experience in construction	-0.050	**0.930**	0.016	0.352	**0.915**	0.290	0.838
D6	Personality characteristics of workers	0.202	**0.698**	-0.014	0.488	**0.778**	0.335	0.637
D9	Good emotional state of workers	0.002	**0.858**	-0.038	0.341	**0.846**	0.243	0.717
D10	Providing feedback from workers to management	0.084	**0.747**	0.047	0.427	**0.798**	0.341	0.648
Group 3: Management staff-related SC factors of local workers (MFL) (eigenvalue = 2.457; % of variance explained = 8.054, cumulative % = 68.519)								
D16	Adequacy of explanations of procedures, rules and policy by management	0.011	-0.058	**0.768**	0.448	0.198	**0.756**	0.575
D17	Active and careful listening to workers	-0.038	0.066	**0.841**	0.495	0.324	**0.840**	0.708
D19	Adequacy of time when communicating with workers	-0.080	0.090	**0.824**	0.453	0.325	**0.806**	0.657
D20	Appropriateness of time when safety information is provided	0.015	0.053	**0.753**	0.490	0.305	**0.779**	0.610
D21	Building trust within the team	0.130	0.001	**0.777**	0.597	0.309	**0.855**	0.742
D22	Relevance and accuracy of safety information provided by management	0.133	-0.065	**0.714**	0.534	0.224	**0.772**	0.607

Note: Major loadings for each variable are shown in boldface.

6.3.5 Empirical results of the measurement models

In order to test the direct and indirect effects of safety communication factors on the safety performance of EMs, Models 1, 2 and 3 were proposed, as shown in Sections 6.3.6, 6.3.7, and 6.3.8. To analyse the three proposed models, both the measurement model and structural model were evaluated. The latent variables involved in these three models included WFL, MFL, OFL, KNOWL, MOTIV, COMP, and PART. WFL, MFL and OFL were exogenous variables, which were derived from EFA on critical SC factor for local workers. KNOWL and MOTIV were mediating variables, and COMP and PART were endogenous variables, which was consistent with those in Model 2 and 3. The reliability and validity of the seven latent constructs used in the three structural equation models were tested, as shown in Table 6.14.

Table 6.14 Reliability and validity measure of seven constructs in Model 4, 5, 6

Latent variables	Cronbach alpha	CR	WFL	MFL	OFL	KNOWL	MOTIV	COMP	PART
WFL	0.890	0.899	**0.642**						
MFL	0.898	0.890	*0.379* (0.144)	**0.575**					
OFL	0.921	0.921	*0.470* (0.221)	*0.737* (0.543)	**0.626**				
KNOWL	0.943	0.944	*0.380* (0.144)	*0.577* (0.333)	*0.567* (0.321)	**0.848**			
MOTIV	0.926	0.927	*0.304* (0.092)	*0.595* (0.354)	*0.601* (0.361)	*0.762* (0.581)	**0.808**		
COMP	0.933	0.928	*0.318* (0.101)	*0.497* (0.247)	*0.498* (0.248)	*0.681* (0.464)	*0.673* (0.453)	**0.811**	
PART	0.935	0.930	*0.347* (0.120)	*0.522* (0.272)	*0.531* (0.282)	*0.685* (0.469)	*0.681* (0.464)	*0.672* (0.452)	**0.816**

Note: The values presented in bold along the diagonal are AVE; the values in italic are correlation coefficients of the seven components; the values in brackets are squared correlation coefficients of the seven components.

The reliability of the seven constructs was achieved as:

- All Cronbach alpha coefficients of the seven latent constructs, which ranged between 0.890 and 0.943, were higher than 0.70.
- The proportion of item-item correlation coefficients within each construct ranging within 0.20 to 0.70 was greater than 50% and item-total correlation values were all higher than 0.30.

- The values of CR ranged from 0.890 (for MFL) to 0.944 (for KNOWL) and were all higher than the threshold of 0.70.

The validity of constructs was also achieved as:

- The standardised factor loadings of all observed variables on the seven latent constructs exceeded the threshold 0.50 (see Table 6.20).
- The values of AVE ranging from 0.575 to 0.848 were higher than the suggested threshold 0.50.
- The correlation coefficients among seven constructs ranged from 0.304 to 0.762, and the squared correlation coefficients of the seven components ranged from 0.092 to 0.581. The values of AVE in bold along diagonal exceeded the squared correlation coefficients in its rows and columns, indicating that the seven components had adequate discriminant validity.

6.3.6 Direct effects of SC factors on safety performance of local worker

6.3.6.1 Hypothesised structural equation model 4

Structural equation Model 4 was proposed to test the direct effects of three SC factors of local workers on their safety performance. Five measurement models were involved in Model 4. The first three measurement models depicted the three SC factors for local workers (i.e., WFL, MFL, and OFL), which were derived from EFA. The other two measurement models presented two indicators of safety performance (i.e., COMP and PART), which were same with those in Model 1. The structural model was constructed to measure the direct effects of three latent SC factors on two latent indicators of safety performance of local workers. The WFL, MFL, and OFL were defined as independent variables, and COMP and PART were defined as dependent variables. Six hypotheses were tested as follows:

- H_{1a}: WFL has a positive direct effect on COMP of local workers.
- H_{1b}: MFL has a positive direct effect on COMP of local workers.
- H_{1c}: OFL has a positive direct effect on COMP of local workers.

- H_{1d}: WFL has a positive direct effect on PART of local workers.
- H_{1e}: MFL has a positive direct effect on PART of local workers.
- H_{1f}: OFL has a positive direct effect on PART of local workers.

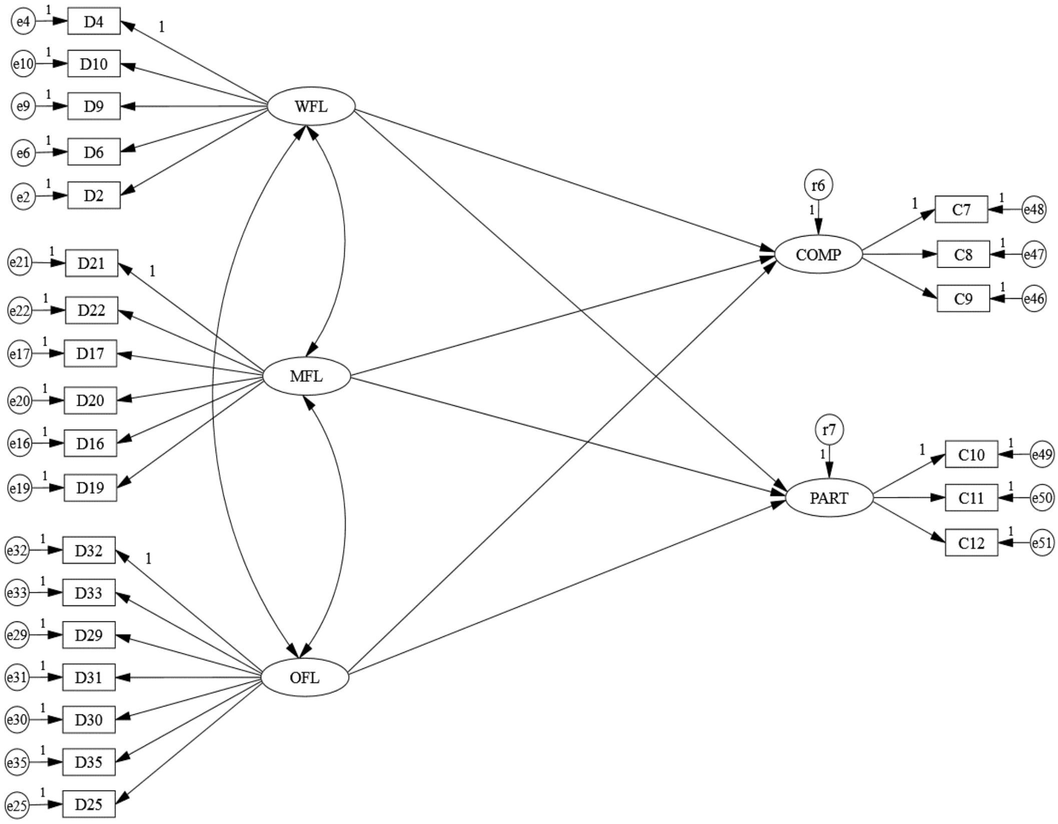

Figure 6.5 Hypothesised structural equation model 4 (Model 4)

Note: Model 4 was hypothesised to test direct effects of SC factors on safety performance of local workers

6.3.6.2 Empirically tested structural equation model 4

The maximum likelihood estimates for the various parameters of the overall fit in the structural model are given in Table 6.15. The fit statistics indicated that the hypothesised structural model achieved an acceptable fit that justified no further interpretation. The values of goodness-of-fit of structural equation model 4 are presented in Table 6.15. All fit indices in Model 4 achieved an acceptable level (RMSEA = 0.077, IFI = 0.923, TLI = 0.910, CFI = 0.922, PNFI = 0.757, PGFI = 0.661, PCFI = 0.805, χ^2/df = 2.202).

Table 6.15 Goodness-of-fit indices of Model 4

Goodness-of-fit Measures		Model 4	Levels of Acceptable Fit	References
Absolute fit	RMSEA	0.077	< 0.8	Schermelleh-Engel et al., (2003); Xiong et al., (2015)
Incremental fit	IFI	0.923	> 0.9	Bagozzi and Yi, (1988); Hu and Bentler, (1995); Hooper et al., (2008); Xiong et al., (2015)
	TLI	0.910		
	CFI	0.922		
Parsimonious fit	PNFI	0.757	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PGFI	0.661	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PCFI	0.805	> 0.5	Xiong et al., (2015)
	χ^2/df	2.202	< 3.0	Patel and Jha (2016); Xiong et al., (2015)

Table 6.16 and Figure 6.6 present the regression results of Model 4, including correlation between exogenous constructs, factor loading, standardised factor loading (β), squared multiple correlations (R^2), standardised error (S.E.), the critical ratios (C.R.), and the *p*-values. Path coefficients on the arrows of the structural model indicated the strength of connections among the five latent constructs. Model 4 accounted for 30.3% of the variance in safety compliance and 33.8% of the variance in safety participation. Four hypotheses (i.e., H_{1b}, H_{1c}, H_{2b}, and H_{2c}) were supported, whereas two hypotheses (i.e., H_{1a} and H_{2a}) were rejected.

Hypothesis H_{1a} was not supported: The direct relationship between WFL and COMP was not significant (β = 0.089, t = 1.193, p > 0.05), indicating WFL had no significantly positive effect on the COMP of local workers.

Hypothesis H_{1b} was supported: The direct relationship between MFL and COMP was significantly positive (β = 0.275, t = 2.547, p < 0.05). The standardised path coefficient from MFL to COMP was 0.275, indicating that one unit of increase in MFL contributed to approximately 0.275 unit of increase in the COMP of local workers.

Hypothesis H_{1c} was supported: The direct relationship between OFL and COMP was significantly positive (β = 0.269, t = 2.397, p < 0.05). The standardised path coefficient from OFL to COMP was 0.269. It indicated that one unit of increase in OFL contributed to approximately 0.269 unit of increase in the COMP of local workers.

Hypothesis H_{2a} was not supported. The direct relationship between WFL and PART was not significant (β = 0.106, t = 1.450, p > 0.05), indicating WFL had no significantly positive effect on the PART of local workers.

Hypothesis H_{2b} was supported: MF showed a significantly positive correlation with PART (β = 0.270, t = 2.565, p < 0.01). The standardised path coefficient from MFL to PART was 0.270, indicating that one unit of increase in MFL contributed to approximately 0.270 unit of increase in the PART of local workers.

Hypothesis H_{2c} was supported: The direct relationship between OFL and PART was significantly positive (β = 0.296, t = 2.726, p < 0.01). The standardised path coefficient from OFL to PART was 0.296, indicating that one unit of increase in OFL contributed to approximately 0.296 unit of increase in the PART of local workers.

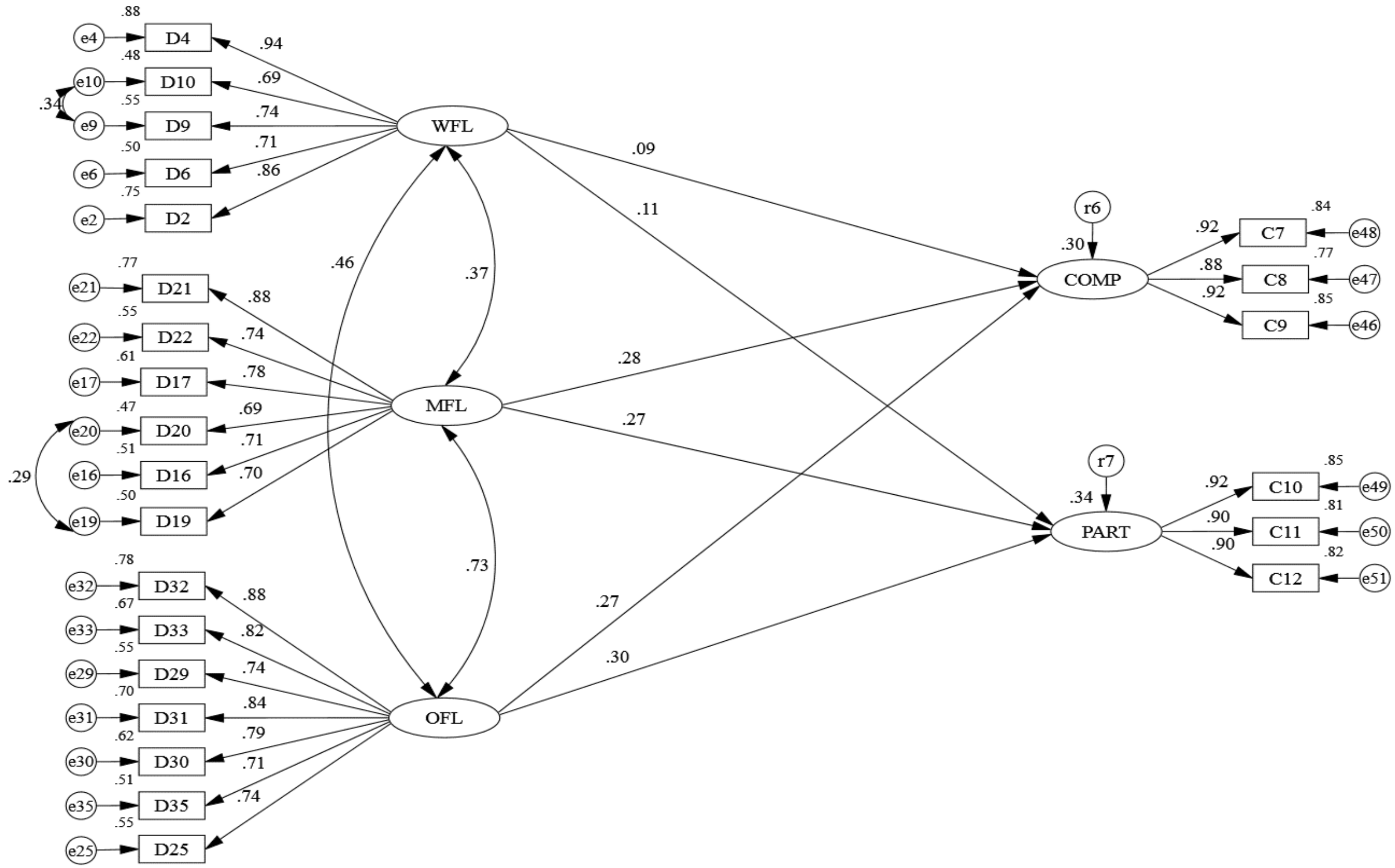

Figure 6.6 Model 4 with standardised path coefficients

Note: Path estimate are standardised coefficients; R^2 = Squared multiple correlations; Two-tailed test.

Table 6.16 Regression weights for each path and its significance in Model 4

Path			Factor loading	β	R^2	S.E.	C.R.	p
COMP	←	WFL	0.066	0.089		0.055	1.193	n.s.
COMP	←	MFL	0.244	0.275	0.303	0.096	2.547	*
COMP	←	OFL	0.242	0.269		0.101	2.397	*
PART	←	WFL	0.087	0.106		0.060	1.450	n.s.
PART	←	MFL	0.263	0.270	0.338	0.103	2.565	**
PART	←	OFL	0.294	0.296		0.108	2.726	**
D20	←	MFL	0.840	0.782	0.611	0.064	13.034	***
D23	←	MFL	0.761	0.688	0.473	0.069	10.981	***
D19	←	MFL	0.845	0.711	0.506	0.073	11.563	***
D35	←	OFL	1.000	0.884	0.880	–	–	–
D36	←	OFL	0.958	0.821	0.476	0.063	15.176	***
D32	←	OFL	0.854	0.743	0.781	0.066	12.915	***
D34	←	OFL	0.964	0.840	0.675	0.060	16.099	***
D33	←	OFL	0.923	0.785	0.552	0.065	14.104	***
D7	←	WFL	1.000	0.938	0.705	–	–	–
D13	←	WFL	0.660	0.690	0.548	0.056	11.859	***
D12	←	WFL	0.743	0.740	0.617	0.056	13.249	***
C12	←	COMP	1.025	0.923	0.852	0.049	20.794	***
C11	←	COMP	0.985	0.880	0.774	0.052	18.961	***
C10	←	COMP	1.000	0.917	0.841	–	–	–
C14	←	PART	1.000	0.922	0.851	–	–	–
C15	←	PART	0.971	0.902	0.813	0.048	20.296	***
C16	←	PART	0.985	0.904	0.817	0.048	20.357	***
D39	←	OFL	0.778	0.711	0.506	0.065	11.987	***
D22	←	MFL	0.820	0.705	0.767	0.072	11.349	***
D28	←	OFL	0.801	0.743	0.497	0.061	13.057	***
D9	←	WFL	0.660	0.706	0.552	0.055	12.077	***
D25	←	MFL	0.881	0.745	0.555	0.071	12.422	***
D24	←	MFL	1.000	0.876	0.499	–	–	–
D3	←	WFL	0.979	0.865	0.748	0.053	18.502	***

Note: β = Standardised factor loading; S.E. = standardised error; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, n.s. represents not significant, $p > 0.05$; C.R. = critical ratio (t value); R^2 = Squared multiple correlations.

6.3.7 Direct effects of safety knowledge and motivation on the safety performance of local workers

6.3.7.1 Hypothesised structural equation model 5

Model 5 was proposed to test the direct effects of safety knowledge and safety motivation on the safety performance of local workers (i.e., COMP and PART). As shown in Figure 6.7, hypothesised Model 5 comprised a structural model and four measurement models. Both structural model and measurement models in Model 5 were consistent with those in model 2. The four measurement models depicted the two determinants of safety performance (i.e., KNOWL and MOTIV) and two indicators of safety performance (i.e., COMP and PART). Four hypotheses were tested as follows:

- H_{3a}: KNOWL has a positive direct effect on COMP of local workers.
- H_{3b}: MOTIV has a positive direct effect on COMP of local workers.
- H_{4a}: KNOWL has a positive direct effect on PART of local workers.
- H_{4b}: MOTIV has a positive direct effect on PART of local workers.

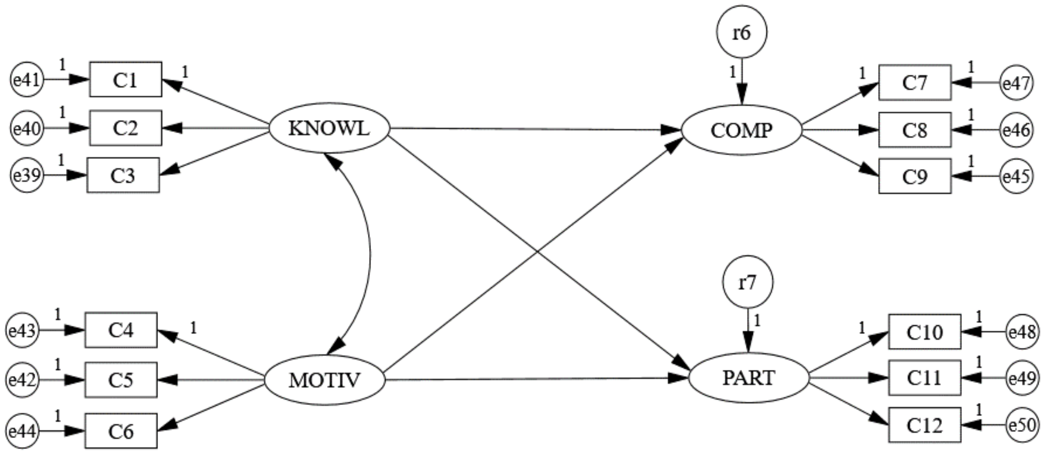

Figure 6.7 Hypothesised structural equation model 5 (Model 5)

Note: Model 5 was hypothesised to test direct effects of safety knowledge and safety motivation on safety performance of local workers.

6.3.7.2 Empirically tested structural equation model 5

Model 5 exhibited a good fit with the data collected (see Table 6.17). All fit indices in Model 5 achieved an acceptable level (RMSEA = 0.042, IFI = 0.993, TLI = 0.990, CFI = 0.993, PNFI = 0.723, PGFI = 0.595, PCFI = 0.737, and $\chi^2/df = 1.358$).

Table 6.17 Goodness-of-fit of Model 5

Goodness-of-fit Measures		Model 5	Levels of Acceptable Fit	References
Absolute fit	RMSEA	0.042	< 0.8	Schermelleh-Engel et al., (2003); Xiong et al., (2015)
Incremental fit	IFI	0.993	> 0.9	Bagozzi and Yi, (1988); Hu and Bentler, (1995); Hooper et al., (2008); Xiong et al., (2015)
	TLI	0.990		
	CFI	0.993		
Parsimonious fit	PNFI	0.723	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PGFI	0.595	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PCFI	0.737	> 0.5	Xiong et al., (2015)
	χ^2/df	1.358	< 3.0	Patel and Jha (2016); Xiong et al., (2015)

As shown in Table 6.18, the values of R^2 of COMPL and PART were 0.533 and 0.542, respectively, representing that 53.3% of COMPL and 54.2% of PART could be measured by using KOWNL and MOTIV. All four hypotheses (i.e., H_{3a}, H_{3b}, H_{4a}, and H_{4b}) in Model 5 were supported.

Hypothesis H_{3a} was supported: KNOWL had a significantly positive direct effect on the COMP of local workers (β = 0.402, t = 4.331, p < 0.001). The estimated weight indicated that when KNOWL went up by 1 the COMP of local workers changed by 0.40.

Hypothesis H_{3b} was supported: The direct relationship between MOTIV and COMP was significantly positive (β = 0.375, t = 3.986, p < 0.001). The standardised path coefficient from MOTIV to COMP was 0.375, indicating that one unit of increase in MOTIV contributed to approximately 0.375 unit of increase in the COMP of local workers.

Hypothesis H_{4a} was supported: The direct relationship between KNOWL and PART was significantly positive (β = 0.397, t = 4.306, p < 0.001). The standardised path coefficient from KNOWL to PART was 0.397, indicating that one unit of increase in KNOWL contributed to approximately 0.397 unit of decrease in the PART of local workers.

Hypothesis H_{4b} was supported: MOTIV showed a significantly positive correlation with PART (β = 0.387, t = 4.146, p < 0.001). The standardised path coefficient from

MOTIV to PART was 0.387, indicating that one unit of increase in MOTIV contributed to approximately 0.387 unit of decrease in the PART of local workers.

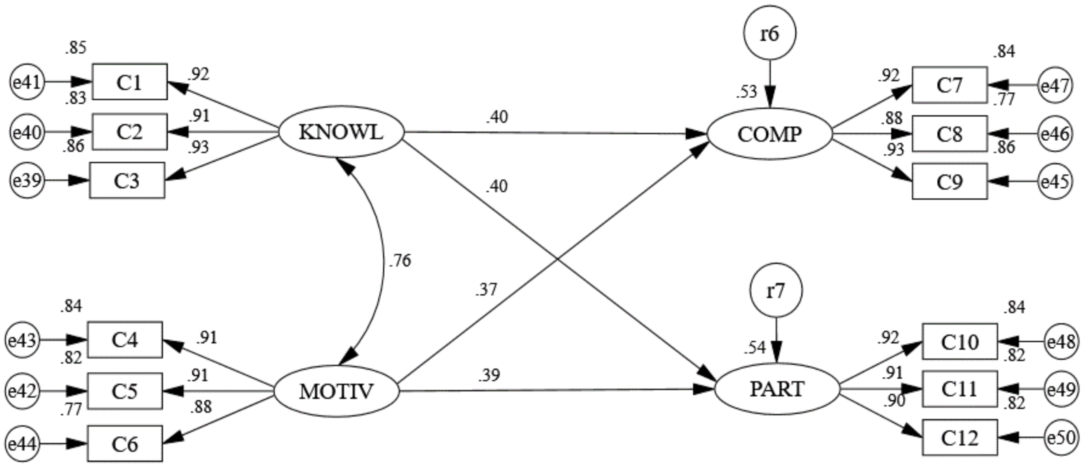

Figure 6.8 Model 5 with standardised path coefficients

Note: Path estimate are standardised coefficients; R^2 = Squared multiple correlations; Two-tailed test.

Table 6.18 Regression weights for each path and its significance in Model 5

		Path	Factor loading	β	R^2	S.E.	C.R.	p
COMP	←	KNOWL	0.375	0.402	0.533	0.087	4.331	***
COMP	←	MOTIV	0.381	0.375		0.096	3.986	***
PART	←	KNOWL	0.407	0.397	0.542	0.094	4.306	***
PART	←	MOTIV	0.432	0.387		0.104	4.146	***
C3	←	KNOWL	1.029	0.930	0.865	0.046	22.591	***
C2	←	KNOWL	1.029	0.913	0.833	0.048	21.657	***
C1	←	KNOWL	1.000	0.920	0.847	–	–	–
C5	←	MOTIV	0.979	0.907	0.822	0.048	20.459	***
C4	←	MOTIV	1.000	0.914	0.835	–	–	–
C6	←	MOTIV	0.967	0.876	0.768	0.052	18.503	***
C9	←	COMP	1.030	0.926	0.857	0.049	21.161	***
C8	←	COMP	0.985	0.878	0.771	0.052	19.004	***
C7	←	COMP	1.000	0.915	0.837	–	–	–
C10	←	PART	1.000	0.917	0.840	–	–	–
C11	←	PART	0.982	0.907	0.822	0.048	20.502	***
C12	←	PART	0.992	0.905	0.818	0.048	20.454	***

Note: β = Standardised factor loading; S.E. = standardised error; *p < 0.05, **p < 0.01, ***p < 0.001, n.s. represents not significant, p > 0.05; C.R. = critical ratio (t-value); R^2 = Squared multiple correlations.

6.3.8 Indirect effects of SC factors on the safety performance of local workers

6.3.8.1 Hypothesised structural equation model 6

Model 6 was developed to test the indirect effects of three SC factors of local workers on their safety performance. Compared with Model 4, two mediators, namely KNOWL and MOTIV, were included. As shown in Figure 6.9, hypothesised Model 6 comprised a structural model and seven measurement models. Among the seven measurement models, five measurement models (i.e., WFL, MFL, OFL, COMP and PART) were the same as those in Model 4 and two measurement models (i.e., KNOWL and MOTIV) were the same as those in Model 5. The structural model in Model 6 depicted the direct effects and indirect effects of three latent SC factors on two latent indicators of safety performance of local workers.

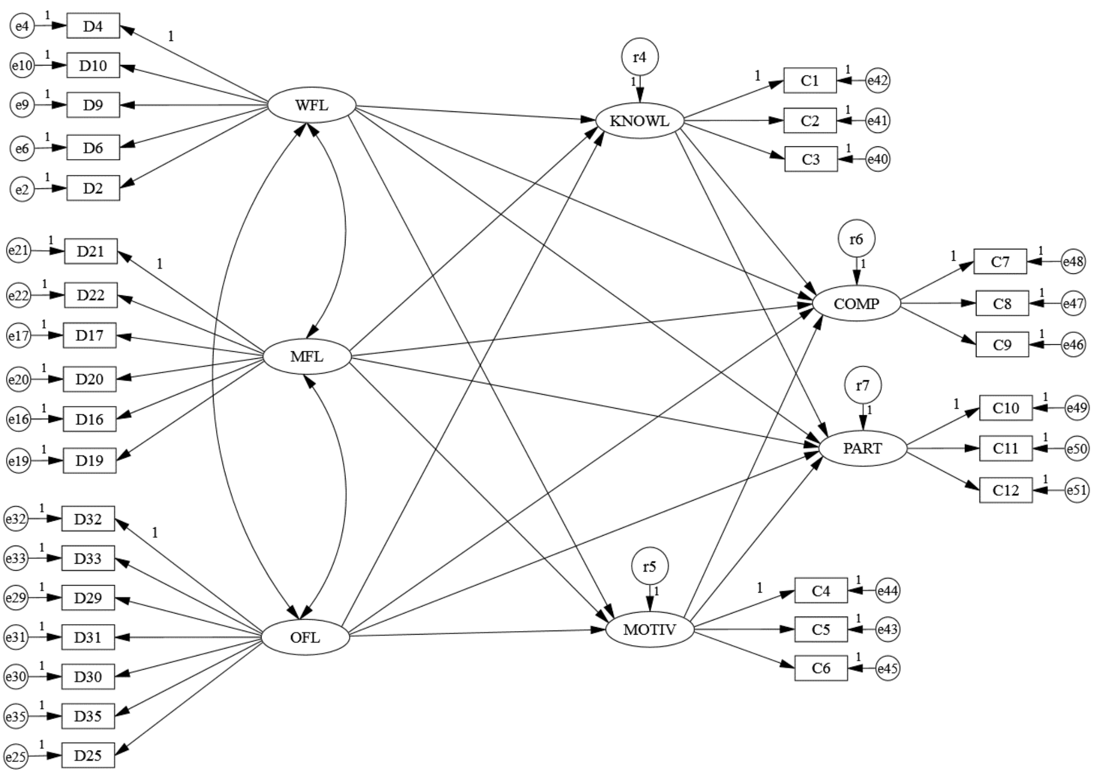

Figure 6.9 Hypothesised structural equation model 6 (Model 6)

Note: Model 6 was hypothesised to test indirect effects of three SC factors on safety performance of local workers.

WFL, MFL, and OFL were independent variables, KNOWL and MOTIV were mediators, and COMP and PART were dependent variables. Six hypotheses were tested as follows:

- H_{5a}: WFL has a positive indirect effect on COMP of local workers.
- H_{5b}: MFL has a positive indirect effect on COMP of local workers.
- H_{5c}: OFL has a positive indirect effect on COMP of local workers.
- H_{6a}: WFL has a positive indirect effect on PART of local workers.
- H_{6b}: MFL has a positive indirect effect on PART of local workers.
- H_{6c}: OFL has a positive indirect effect on PART of local workers.

6.3.8.2 Empirically tested structural equation model 6

The structural model 6 exhibited a good fit with the data collected. The values of goodness-of-fit are presented in Table 6.19. All fit indices in Model 6 achieved an acceptable level (RMSEA = 0.070, IFI = 0.927, TLI = 0.917, CFI = 0.926, PNFI = 0.765, PGFI = 0.633, PCFI = 0.822, χ^2/df = 1.977).

Table 6.19 Goodness-of-fit of Model 6

Goodness-of-fit Measures		Model 6	Levels of Acceptable Fit	References
Absolute fit	RMSEA	0.070	< 0.8	Schermelleh-Engel et al., (2003); Xiong et al., (2015)
Incremental fit	IFI	0.927	> 0.9	Bagozzi and Yi, (1988); Hu and Bentler, (1995); Hooper et al., (2008); Xiong et al., (2015)
	TLI	0.917		
	CFI	0.926		
Parsimonious fit	PNFI	0.765	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PGFI	0.663	> 0.5	Patel and Jha (2016); Xiong et al., (2015)
	PCFI	0.822	> 0.5	Xiong et al., (2015)
	χ^2/df	1.977	< 3.0	Patel and Jha (2016); Xiong et al., (2015)

The regression results including correlation between exogenous constructs, factor loading, standardised factor loading (β), squared multiple correlations (R^2), standardised error (S.E.), the critical ratios (C.R.), and the p-values are presented in Table 6.20 and Figure 6.10. The indirect and direct effects of exogenous variables on endogenous variables are depicted in Table 6.21. Testing results of mediators (KNOWL and MOTIV) are shown in Table 6.22. Two hypotheses (i.e., H_{5b} and H_{6b}) were supported, whereas four hypotheses (i.e., H_{5a}, H_{5c}, H_{6a}, and H_{5c}) were rejected.

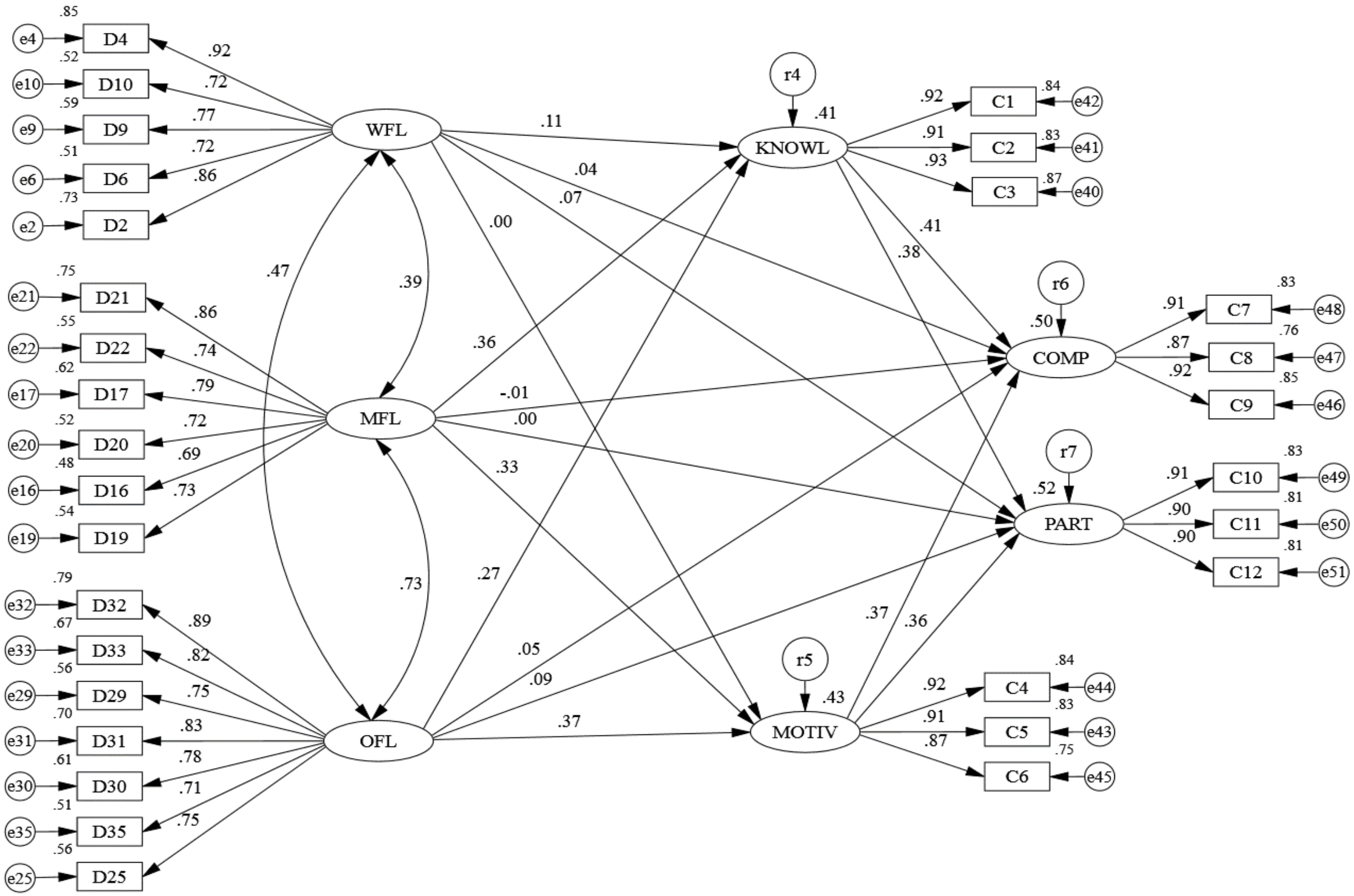

Figure 6.10 Model 6 with standardised path coefficients

Note: Path estimate are standardised coefficients; R^2 = Squared multiple correlations; Two-tailed test.

Table 6.20 Regression weights for each path and its significance in Model 6

Path			Factor loading	β	R^2	S.E.	C.R.	p
MOTIV	⟵	WFL	0.002	0.003		0.052	0.047	n.s.
MOTIV	⟵	MFL	0.289	0.328	0.427	0.089	3.252	*
MOTIV	⟵	OFL	0.329	0.373		0.092	3.593	*
KNOWL	⟵	WFL	0.090	0.112		0.056	1.604	n.s.
KNOWL	⟵	MFL	0.340	0.355	0.414	0.097	3.515	*
KNOWL	⟵	OFL	0.262	0.273		0.099	2.642	**
COMP	⟵	KNOWL	0.364	0.406		0.081	4.481	**
COMP	⟵	MOTIV	0.361	0.370		0.091	3.975	**
COMP	⟵	WFL	0.032	0.044	0.498	0.048	0.663	n.s.
COMP	⟵	MFL	-0.005	-0.005		0.086	-0.053	n.s.
COMP	⟵	OFL	0.043	0.050		0.087	0.500	n.s.
PART	⟵	KNOWL	0.378	0.382		0.088	4.310	**
PART	⟵	MOTIV	0.387	0.361		0.098	3.954	**
PART	⟵	WFL	0.052	0.066	0.518	0.052	1.003	n.s.
PART	⟵	MFL	0.001	0.001		0.092	0.006	n.s.
PART	⟵	OFL	0.081	0.086		0.093	0.874	n.s.
D20	⟵	MFL	0.856	0.786	0.618	0.065	13.174	***
D23	⟵	MFL	0.813	0.724	0.524	0.070	11.672	***
D19	⟵	MFL	0.835	0.693	0.481	0.075	11.177	***
D35	⟵	OFL	1.000	0.888	0.854	–	–	–
D36	⟵	OFL	0.950	0.818	0.521	0.063	15.177	***
D32	⟵	OFL	0.852	0.745	0.789	0.065	13.044	***
D34	⟵	OFL	0.953	0.834	0.670	0.060	16.007	***
D33	⟵	OFL	0.914	0.782	0.555	0.065	14.069	***
D7	⟵	WFL	1.000	0.924	0.695	–	–	–
D13	⟵	WFL	0.701	0.722	0.588	0.057	12.347	***
D12	⟵	WFL	0.781	0.767	0.611	0.057	13.708	***
C3	⟵	KNOWL	1.032	0.931	0.867	0.046	22.380	***
C2	⟵	KNOWL	1.030	0.913	0.833	0.048	21.504	***
C1	⟵	KNOWL	1.000	0.919	0.845	–	–	–
C8	⟵	MOTIV	0.981	0.912	0.832	0.048	20.468	***
C6	⟵	MOTIV	1.000	0.917	0.841	–	–	–
C9	⟵	MOTIV	0.954	0.867	0.752	0.052	18.170	***
C12	⟵	COMP	1.029	0.920	0.846	0.049	21.142	***
C11	⟵	COMP	0.984	0.870	0.756	0.052	19.002	***
C10	⟵	COMP	1.000	0.910	0.828	–	–	–
C14	⟵	PART	1.000	0.912	0.832	–	–	–
C15	⟵	PART	0.980	0.900	0.810	0.048	20.515	***
C16	⟵	PART	0.991	0.898	0.807	0.048	20.491	***
D39	⟵	OFL	0.776	0.712	0.507	0.064	12.065	***
D22	⟵	MFL	0.864	0.732	0.746	0.073	11.888	***
D28	⟵	OFL	0.801	0.746	0.536	0.061	13.214	***
D9	⟵	WFL	0.679	0.716	0.556	0.055	12.290	***
D25	⟵	MFL	0.888	0.740	0.547	0.072	12.281	***
D24	⟵	MFL	1.000	0.864	0.513	–	–	–
D3	⟵	WFL	0.983	0.856	0.732	0.054	18.111	***

Note: β = Standardised factor loading; S.E. = standardised error; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, n.s. represents not significant, $p > 0.05$; C.R. = critical ratio (t value); R^2 = Squared multiple correlations.

Table 6.21 Direct, indirect, and total effects in Model 6

Endogenous variables	Exogenous variables	Standardised direct effects		Standardised indirect effects		Standardised total effects	
		β	*p*	*β*	*p*	*β*	*p*
KNOWL	WFL	0.112	0.268	–	–	0.112	0.268
	MFL	0.355	0.010*	–	–	0.355	0.010*
	OFL	0.273	0.131	–	–	0.273	0.131
MOTIV	WFL	0.003	0.902	–	–	0.003	0.902
	MFL	0.328	0.012*	–	–	0.328	0.012*
	OFL	0.373	0.098	–	–	0.373	0.098
COMP	WFL	0.044	0.545	0.047	0.527	0.091	0.372
	MFL	-0.005	0.871	0.266	0.004**	0.260	0.129
	OFL	0.050	0.615	0.249	0.080	0.300	0.110
	KNOWL	0.406	0.007**	–	–	0.406	0.007**
	MOTIV	0.370	0.007**	–	–	0.370	0.007**
PART	WFL	0.066	0.349	0.044	0.539	0.110	0.226
	MFL	0.001	0.990	0.254	0.009**	0.255	0.053
	OFL	0.086	0.513	0.239	0.075	0.325	0.158
	KNOWL	0.382	0.007**	–	–	0.382	0.007**
	MOTIV	0.361	0.009**	–	–	0.361	0.014*

Note: β = Standardised factor loading; $*p < 0.05$, $**p < 0.01$.

Table 6.22 Testing results of mediators (KNOWL and MOTIV) in Model 6

Indirect effects (mediated relationships)	Indirect effects	Bias-Corrected 95% CI		*p*
		Lower 2.5%	Upper 2.5%	
WFL → KNOWL → COMP	0.045	-0.012	0.109	0.192
WFL → MOTIV → COMP	0.001	-0.053	0.069	0.903
MFL → KNOWL → COMP	0.144	0.029	0.307	0.008**
MFL → MOTIV → COMP	0.121	0.031	0.265	0.006**
OFL → KNOWL → COMP	0.111	-0.021	0.236	0.082
OFL → MOTIV → COMP	0.138	0.022	0.242	0.022*
WFL → KNOWL → PART	0.043	-0.012	0.097	0.166
WFL → MOTIV → PART	0.001	-0.064	0.079	0.903
MFL → KNOWL → PART	0.136	0.016	0.268	0.036*
MFL → MOTIV → PART	0.118	0.017	0.309	0.010*
OFL → KNOWL → PART	0.104	-0.012	0.302	0.073
OFL → MOTIV → PART	0.135	0.026	0.271	0.024*

Note: $*p < 0.05$, $**p < 0.01$.

Hypothesis H_{5a} was not supported: The indirect effect of WFL on the COMP of local workers was not significant ($p > 0.05$) (Table 6.21). In Model 6, KNOWL ($\beta = 0.406$, $t = 4.481$, $p < 0.01$) and MOTIV ($\beta = 0.370$, $t = 3.975$, $p < 0.01$) had a significantly positive influence on the COMP of local workers (see Table 6.20); however, WFL did not significantly influence the KNOWL ($p > 0.05$) and MOTIV ($p > 0.05$) of local construction workers (see Table 6.20).

Hypothesis H_{5b} was supported: The indirect effect of MFL on the COMP of local workers was significant ($\beta = 0.266$, $p < 0.01$) (see Table 6.21). The standardised indirect effect of MFL on COMP was 0.266. MF had a significantly positive effect on KNOWL ($\beta = 0.355$, $t = 3.515$, $p < 0.05$) and MOTIV ($\beta = 0.328$, $t = 3.252$, $p < 0.05$), and KNOWL ($\beta = 0.406$, $t = 4.481$, $p < 0.01$) and MOTIV ($\beta = 0.370$, $t = 3.975$, $p < 0.01$) had a significantly positive influence on the COMP of local workers (see Table 6.20).

The direct effect of MFL on the COMP of local workers was significant ($\beta = 0.395$, $t = 4.845$, $p < 0.001$) in Model 4, but was non-significant ($p > 0.05$) after entering the two mediators (i.e., KNOWL and MOTIV) into Model 6, indicating that KNOWL and MOTIV completely mediated the relation between MFL and COMP. The indirect effect of MFL on COMP via KNOWL and MOTIV was 0.144 and 0.121, respectively.

Hypothesis H_{5c} was not supported: The indirect effect of OFL on the COMP of local workers was not significant ($p > 0.05$). OFL did not significantly influence the KNOWL ($p > 0.05$) and MOTIV ($p > 0.05$) of local construction workers (see Table 6.20). Both KNOWL (95% BC CI [-0.012, 0.097], range included zero, $p > 0.05$) and MOTIV (95% BC CI [-0.064, 0.079], range included zero, $p > 0.05$) did not mediate the relationship between WFL and PART of local workers (Table 6.22).

Hypothesis H_{6a} was not supported: The indirect effect of WFL on the PART of local workers was not significant ($p > 0.05$) (Table 6.21). Both KNOWL (95% BC CI [-0.012, 0.097], range included zero, $p > 0.05$) and MOTIV (95% BC CI [-0.064, 0.079], range included zero, $p > 0.05$) did not mediate the relationship between the WFL and PART of local workers (Table 6.22).

Hypothesis H_{6b} was supported: The indirect effect of MFL on the PART of local workers was significant ($\beta = 0.254$, $p < 0.01$) (Table 6.21). The standardised indirect effect of MFL on PART was 0.245. MFL had a significantly positive effect on KNOWL (β = 0.355, t = 3.515, $p < 0.05$) and MOTIV (β = 0.328, t = 3.252, $p < 0.05$). KNOWL (β = 0.382, t = 4.310, $p < 0.01$) and MOTIV (β = 0.361, t = 3.954, $p < 0.01$) had a significantly positive influence on the PART of local workers (see Table 6.20).

The direct effect of MFL on PART of local workers was significant (β = 0.270, t = 2.565, $p < 0.01$) in Model 4, but was not significant (β = 0.001, t = 0.006, $p > 0.05$) after entering the two mediators (i.e., KNOWL and MOTIV) into Model 6 (see Table 6.20), indicating that KNOWL and MOTIV completely mediated the relationship between MFL and PART of local workers. The indirect effect of MFL on PART through KNOWL and MOTIV was 0.136 and 0.118, respectively (see Table 6.22).

Hypothesis H_{6c} was not supported: The overall indirect effect of OFL on the PART of local workers was not significant ($p > 0.05$) through two mediators (Table 6.21). MOTIV (95% BC CI [0.026, 0.271], range did not include zero, $p < 0.05$) mediated the relationship between OFL and PART, while KNOWL (95% BC CI [-0.012, 0.302], range includes zero, $p > 0.05$) did not mediate the effect of OFL on the PART of local workers (Table 6.22).

6.4 CHAPTER SUMMARY

This chapter presented the data analysis and research findings to achieve Objective 4. A comparative analysis of the safety communication factors among EMs, management, and local workers was conducted.

As perceived by management, a total of 17 safety communication factors were critical for EMs. There was significant agreement among management respondents in the rankings of safety communication factors for EMs within each group. There was considerable agreement between any two groups of management staff on the rankings. There was no correlation on the ranks of 36 safety communication factors for EMs between EM respondents and management respondents. The mean values of 22 safety communication factors of EMs in the EM group were significantly higher than those in the management group.

There were 18 critical safety communication factors for local workers. There was no correlation between EMs and local construction workers in the ranking of safety communication factors. The mean scores of 28 safety communication factors in EM group were significantly higher than those in local worker group. According to the perceptions of local workers, WFL had neither direct nor indirect effects on their safety performance (i.e., safety compliance and safety participation). MFL had both direct and indirect effects on safety performance, and OFL only had direct effects on the safety compliance and safety participation of local workers.

Chapter 7: Analysing the Safety Communication Networks of EM Construction Workers

7.1 INTRODUCTION

This chapter presents the research results of Objectives 5, 6, and 7. The predominant safety communication structures of EM crews are built, the relationships between safety communication structures and the safety performance of EM crews are analysed, and the effects of workers' personal attributes on their position in the networks are evaluated.

7.2 SOCIOGRAMS OF EM CREWS

Social network analysis data from section B of the questionnaire in survey 2 were analysed using UCINET software (Borgatti *et al.* 2002). With the help of UCINET, network level measures (i.e., network density and reciprocity), individual level measures (i.e., out-degree, in-degree, out-closeness, in-closeness, and betweenness) were calculated. Questionnaire data from section A (personal attributes), section C (safety climate), and values of network measures were analysed with SPSS. Descriptive statistics were also calculated (Field, 2009). A cross-case comparison from aspects of language ability, safety activities carried out, and network level measures was carried out to seek key differentiators between high performing and low performing crews.

In Figure 7.1, sociograms of the safety communication of six crews are provided, which are visual representations of the safety communication among crew members. All EM crews had similar size and composition (i.e., consisting of frontline EM construction workers and frontline level management). The outgoing arrows represent providing safety information to others at least on a weekly basis, while the incoming arrows represent receiving safety information from others at least on a weekly basis. The key features of the safety communication network can be elicited from the structure of these sociograms.

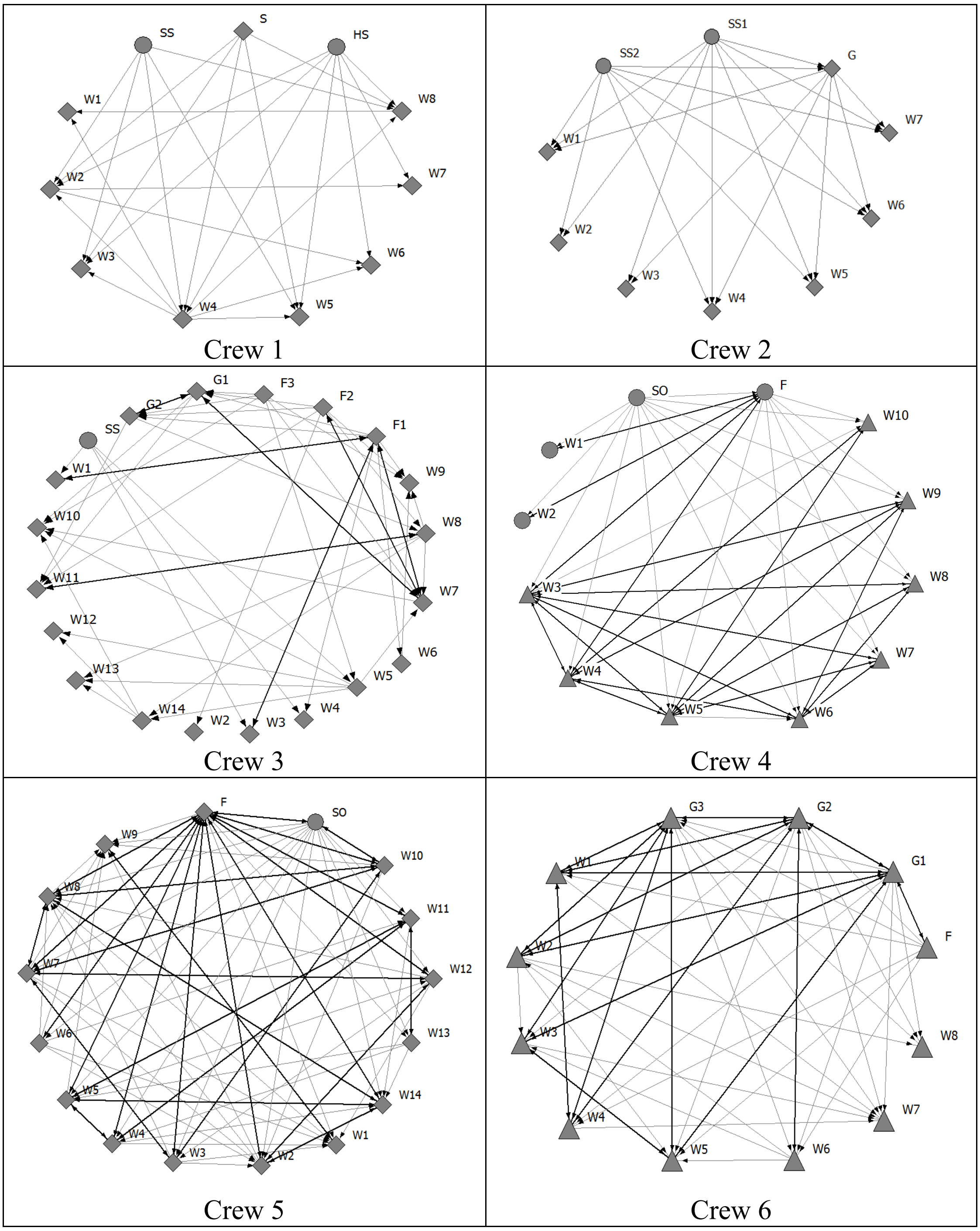

Figure 7.1 Safety communication network for six crews

Note: S represents supervisor, SS represents safety supervisor, HS represents head supervisor, F represents foreman, SO represent safety officer, G represents ganger, and W represents worker. The local people are represented by circles ●, Nepalese are represented by diamonds ◆, and Pakistanis are represented by up triangles ▲. Reciprocated communication is represented by black lines ⟷ , and non-reciprocated communication is represented by grey lines ⟶

7.3 SAFETY CLIMATE AND ACCIDENTS OF EM CREWS

The SCI scores and average number of accidents were calculated for the six crews. Scores of negatively worded questions regarding safety climate were reversed and the mean values of 38 safety climate variables for six crews were calculated to determine the overall SCI of different crews. As shown in Table 7.1, the first three highest SCI scores were for Crews 5, 6, and 4, while SCI scores for Crews 1, 3, and 2 were relatively low. In response to the question "How many accidents have you had in the past six months?", which utilised a three-point Likert scale (see Table 7.1), the percentages of workers with less than two accidents in Crews 5, 6 and 4 were all 100%, higher than those of Crew 1, 3, and 2 (i.e., 87.5%, 64.3%, and 71.5% respectively). Low SCI score crews reported more accidents than high SCI score crews. Based on the SCI scores and workers' experience of accidents, six crews were divided into two categories: high safety performing crews and low safety performing crews. Crews 5, 6, and 4 fell into the high performing crews, and Crews 1, 3, and 2 fell into the low performing crews.

Table 7.1 SCI scores and percentage of workers who had accidents

Category	Crew No.	SCI	Percentage of workers who had accidents		
			< 2 accidents	2 − 5 accidents	> 5 accidents
High performing	5	3.87	100%	0%	0%
	6	3.74	100%	0%	0%
	4	3.67	100%	0%	0%
Low performing	1	3.43	87.5%	12.5%	0%
	3	3.34	64.3%	21.4%	14.3%
	2	3.28	71.5%	28.5%	0%

7.4 EFFECTS OF LANGUAGE ABILITY ON THE SAFETY OF EM CREWS

A cross-case comparison of language ability was carried out to seek key differentiators between high performing and low performing crews. The predominant languages used by all crews investigated for written safety instructions, safety training, and safety meetings in the Hong Kong construction industry were English and Cantonese. As shown in Table 7.2, all EMWs in high performing crews were fluent in the predominant languages (i.e., either English or Cantonese); however, 28%, 25%, and 14% of EMWs in low performing Crews 1, 2, and 3 were not fluent in any of the predominant languages. The results indicate that the language ability of high performing crews was better than that of low performing crews (Finding 1). It is interesting to note that translators or interpreters were rarely used by all EM crews, except for Crew 6. The score of frequency of translators used by Crews 1, 2, 3, 4, and 5 ranged from 2.00 to 2.30, which means EMWs in these crews rarely or very rarely had translators to assist them onsite.

Table 7.2 Language ability of EMWs

Category	Crew No.	No. of EMWs	Workers not fluent in Cantonese or English		Frequency of translator used
			N	Percentage	
High performing	5	14	0	0	2.13
	6	8	0	0	4.88
	4	8	0	0	2.17
Low performing	1	8	2	25%	2.17
	3	14	2	14%	2.30
	2	7	2	28%	2.00

Note: The score of frequency of translators used was observed using a 6-point Likert scale 1-6, where 1 = never, 2 = very rarely, 3 = rarely, 4 = occasionally, 5 = frequently, and 6 = very frequently.

7.5 EFFECTS OF NETWORK LEVEL MEASUREMENTS ON THE SAFETY OF EM CREWS

The idea that differences in crew performance might be explained by the results of structural characteristics of communication networks was tested. As shown in Table 7.3, the network densities of high performing EM crews were higher than those of low performing crews (Finding 2). Specifically, network densities of high performing crews ranged between 0.33 and 0.35, while densities of low performing crews ranged from 0.14 to 0.24. A higher value of density indicated more frequent communication among all crew members in a defined network.

Table 7.3 Network level measures of EM crews

Category	Crew No.	No. of EMWs	Network Density	Arc Reciprocity	Dyad Reciprocity
High performing	5	14	0.35	0.57	0.40
	6	8	0.33	0.56	0.39
	4	8	0.33	0.69	0.53
Low performing	1	8	0.24	0	0
	3	14	0.14	0.26	0.15

	2	7	0.23	0	0

As shown in Table 7.3, high performing crews showed higher values for both arc and dyad reciprocity than low performing crews (Finding 3). Of all incoming and outgoing ties in Crew 5, 6, and 4, 57%, 56%, and 69% were reciprocated, while in Crews 1, 3, and 2, 0%, 26%, and 0% were reciprocated. That is, 57%, 56%, and 69% of crew members in Crews 5, 6, and 4 who sought safety information were sought out for information by those same individuals, while in Crews 1, 3, and 2 the proportions were only 0%, 26%, and 0%, which is fairly low, indicating that there was a hierarchical instead of horizontal structure in the safety communication networks of the low performing crews. The proportions of symmetric pairs in Crews 5, 6, and 4 were 40%, 39%, and 53%, while Crews 1, 3, and 2 were 0%, 15%, and 0%. This indicates that there were fewer reciprocated ties and similarly fewer symmetric pairs in the low performing crews than in the high performing crews. In other words, one-way safety communication occurred more frequently in low performing crews than in high performing crews. This is shown visually in Figure 7.1. In the highest performing crew (Crew 5), reciprocated communication occurred not only between management and EMWs, but also among EMWs. However, EMWs in low performing crews, such as Crews 1 and 2, relied on management to provide safety information, and they seldom provided feedback to their management. Moreover, safety communication among EMWs in these two crews was non-reciprocated, implying EMWs in low performing crews did not openly communicate with leaders or co-workers.

7.6 ROLES OF INDIVIDUALS IN SAFETY COMMUNICATION NETWORKS

A significant difference between management and workers was revealed in out-degree ($p < 0.001$) and in-degree ($p < 0.01$) centrality by the Mann-Whitney *U* test (see Table 7.4). The out-degree of management was significantly higher than that of workers, while in-degree of management was significantly lower than that of workers. This result suggests that management played a central role in providing safety information within EM crews (Finding 4). The sociogram of Crew 1 (see Figure 7.1) shows that the safety supervisor (Actor SS), supervisor (Actor S), and head superior (Actor HS) had the greatest out-degree (N = 5, 5, and 7 respectively), demonstrating the supervisors' critical role in providing safety information to EMWs. The mean value of out-degree of workers was 0.21, which is fairly low.

Table 7.4 Mann-Whitney *U* test for degree centrality by position and nationality of management

Category	Groups	*N*	Out-degree		In-degree	
			Mean	*p*	Mean	*p*
Position	Management	20	0.65	0.000***	0.23	0.009**
	Worker	61	0.21		0.35	
Nationality of management	Local	8	0.74	0.249	0.08	0.048*
	EMs	12	0.58		0.31	

Notes: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$; Two-tailed test.

The difference in degree centrality between local and EM management was also analysed using the Mann-Whitney *U* test. Table 7.4 indicates that there was no difference in out-degree, whereas the in-degree of local management was significantly lower than that of EM management ($p < 0.05$). In other words, both local and EM management played the same effective role in providing safety information to workers, but EM management tended to receive much more safety information than local management from EMWs (Finding 5). For instance, taking the sociogram of Crew 5 (see Figure 7.1), most of the ties between the Nepalese foreman (labelled as F) and Nepalese workers were reciprocated; however, only two ties of the local safety officer (labelled as SO) were reciprocated.

7.7 EFFECTS OF WORKERS' PERSONAL ATTRIBUTES ON THEIR CENTRALITY

The descriptions of eight personal attributes of the EMWs selected are provided in Table 7.5. Whether centrality measures (i.e., out-degree, in-degree, out-closeness, in-closeness, and betweenness) differed significantly by the personal attributes of workers was examined using the Kruskal-Wallis test, as shown in Table 7.6. The results showed that centrality measures of workers did not significantly vary with marital status, tenure, experience, or time of training (Finding 6). This finding is contrary to the expectation that long-time, experienced, and well-trained EMWs were more likely to hold central positions in EM crews. In addition, no significant difference of betweenness was identified by any personal attribute.

Table 7.5 Meaning of personal attributes

Number	Variable	Description
1	Age	Age of workers
2	Marital status	Married or single
3	Educational level	Education level of workers
4	Tenure	How long have been on this job site
5	Experience	Years of experience in the construction industry
6	Priority of safety	How is the priority of safety, compared with time, cost and quality that your senior instructs you (on your current project)
7	Time of training	When did workers receive safety training at current project
8	Language	What languages are workers fluent in

Table 7.6 Kruskal-Wallis test for centrality by personal attributes of workers

Measure	Age		Marital status		Educational level		Tenure	
	χ^2	p	χ^2	p	χ^2	p	χ^2	p
Out-degree	24.300	0.000***	4.294	0.058	7.929	0.094	5.446	0.142
In-degree	24.300	0.000***	0.053	0.819	11.525	0.021*	1.304	0.728
Out-closeness	26.035	0.000***	1.901	0.168	7.881	0.096	1.098	0.778
In-closeness	26.597	0.000***	0.17	0.68	19.419	0.001**	2.042	0.564
Betweenness	12.217	0.057	2.569	0.109	0.634	0.959	6.435	0.092
Measure	Experience		Priority of safety		Time of training		Language	
	χ^2	p	χ^2	p	χ^2	p	χ^2	p
Out-degree	4.002	0.406	5.979	0.050*	2.227	0.694	9.942	0.007**
In-degree	3.531	0.473	13.402	0.001**	1.084	0.897	10.482	0.005**
Out-closeness	4.584	0.333	9.69	0.008**	2.791	0.593	9.488	0.009**
In-closeness	7.194	0.126	15.222	0.000***	2.35	0.672	7.325	0.026*
Betweenness	2.261	0.688	3.09	0.213	4.225	0.376	4.629	0.099

Notes: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

There were significant differences in out-degree ($\chi^2 = 24.300$, $p < 0.001$), in-degree ($\chi^2 = 24.300$, $p < 0.001$), out-closeness ($\chi^2 = 26.035$, $p < 0.001$), and in-closeness ($\chi^2 = 26.597$, $p < 0.001$) among different age groups of EMWs (see Table 7.6). As revealed in Table 7.7, the youngest EMWs (N = 20) had the highest degree centrality and closeness centrality, followed by the second youngest group (i.e., 21 to 30 years) (Finding 7). This finding coincides with the study by Alsamadani et al. (2013b), where workers under 25 years old (youngest group in their sample) had the highest values of centrality.

Table 7.7 Mean and rank of centrality of different groups

Personal attributes	Groups	*N*	Out-degree		In-degree		Out-closeness		In-closeness	
			M	*R*	M	*R*	M	*R*	M	*R*
Age	20 or below	20	0.38	1	0.46	1	0.57	1	0.59	1
	21-30	25	0.17	2	0.37	2	0.40	2	0.47	2
	31-40	9	0.03	4	0.19	3	0.24	4	0.31	4
	> 40	5	0.06	3	0.18	4	0.31	3	0.34	3
Educational level	Below primary	7			0.35	4			0.49	4
	Primary	19			0.43	1			0.56	1
	Secondary	10			0.37	2			0.50	3
	Certificate/Diploma	17			0.24	5			0.34	5
	Degree or higher	6			0.36	3			0.54	2
Priority of safety	Very important	9	0.40	1	0.48	1	0.55	1	0.60	1
	Moderately important	44	0.19	2	0.36	2	0.42	2	0.48	2
	Neutral	6	0.12	3	0.14	3	0.26	3	0.25	3
Language ability	Trilingual	18	0.31	1	0.44	1	0.52	1	0.54	1
	Bilingual	35	0.19	2	0.34	2	0.40	2	0.46	2
	Monolingual	6	0.02	3	0.22	3	0.30	3	0.38	3

Note: M = mean; *R* = rank.

Significant differences were found in in-degree ($\chi^2 = 11.525$, $p < 0.05$) and in-closeness ($\chi^2 = 19.419$, $p < 0.01$) by the educational levels of EMWs (Finding 8) (see Table 7.6). Workers with primary education had the highest in-degree and in-closeness, indicating they received the most safety information compared with other groups (see Table 7.7). It was not expected that workers who received below primary education would be ranked as the fourth in in-degree and in-closeness among the five groups, as it was assumed that workers who were not well educated would receive more safety information from their co-workers and management.

EMWs tended to be more active in the exchange of safety information if they perceived that the organisation valued their safety (Finding 9). This is suggested by the results showing that the out-degree ($\chi^2 = 5.979$, $p < 0.05$), in-degree ($\chi^2 = 13.402$, $p < 0.01$), out-closeness ($\chi^2 = 9.69$, $p < 0.01$), and in-closeness ($\chi^2 = 15.222$, $p < 0.001$) significantly differed with the priority of safety (see Table 7.6). The higher priority of safety that was instructed by seniors to EMWs, the higher out-degree, in-degree, out-closeness and in-closeness they had in crew networks, as revealed in Table 7.7.

Trilingual and bilingual EMWs play a more significant role in safety communication within EM crews than monolingual EMWs (Finding 10). A total of 18 EMWs investigated in this study were trilingual, namely their own native language (i.e., Urdu or Nepali), and the two predominant languages used on the construction site (i.e., English and Cantonese). More than half of the EMWs ($N = 35$) expressed that they were bilingual, namely their native language and one predominant language (i.e., English or Cantonese). The remaining six EMWs were monolingual (i.e., Nepali or Urdu), and could not understand English or Cantonese at all. As revealed by Table 7.7, there were significant differences among the different language abilities of EMWs in their out-degree ($\chi^2 = 9.942$, $p < 0.01$), in-degree ($\chi^2 = 10.482$, $p < 0.01$), out-closeness ($\chi^2 = 9.488$, $p < 0.01$), and in-closeness ($\chi^2 = 7.325$, $p < 0.05$). Trilingual EMWs showed the highest degree centrality and closeness centrality, followed by bilingual workers. Monolingual workers had the lowest score for out-degree, implying they seldom provided safety information to other crew members. Apart from out-degree, the in-degree of monolingual workers was also the lowest, indicating they received the least safety information from others.

7.8 CHAPTER SUMMARY

This study analysed the safety communication networks of EM crews and explored their relationships with personal attributes, and EMWs' safety experience. A questionnaire survey was conducted face-to-face with six EM crews, consisting of 82 respondents on construction sites in Hong Kong. Data were analysed using the social network analysis technique, cross-case comparison, and nonparametric tests. The results revealed that language proficiency, network density, and level of reciprocity were contributing factors that distinguished the high and low safety performing EM crews. EM management received more safety information from EMWs than local management. The centrality of EMWs was significantly related to their age, the perceived priority of safety, and their language ability. This research contributes to developing effective communication network patterns for EM construction workers. The findings will be useful for improving the safety of EM construction workers.

Chapter 8: Discussion and Recommendations

8.1 INTRODUCTION

This chapter explains the key research findings of the seven objectives reported in Chapters 4, 5, 6, and 7, interprets and discusses the research findings in the context of theories and previous research, and provides some recommendations about how to improve the safety communication and safety performance of EM construction workers.

8.2 SAFETY AND HEALTH PROBLEMS OF EMS

This study identified four categories and 14 subcategories of safety and health problems of EMWs. The main categories included "insufficient organisational interventions/strategies to support EMWs", "insufficient government support for EMWs, language and communication barriers of EMWs", and "low skill level and safety awareness of EMWs". It is noted that these categories had intricate relationships. The four main categories of safety and health problems of EMWs demonstrate that both the industry and the government are not prepared well for the recent increasing employment of EMWs in the construction industry. The employers have not developed a safety culture for better embracing an increasing number of EM construction workers and the government provides limited support for the industry to cope with this change. The problem of low skill and safety awareness of the EMWs, together with language and communication barriers, make EMWs become the most vulnerable group in the construction industry.

As shown in Table 2.1, most of the identified 14 subcategories of safety and health problems encountered by EMWs shared similarities with previous studies. It indicated that the safety and health problems influencing safety performance of EMWs in the Hong Kong construction industry are also commonly faced by some EMWs in other jurisdictions (e.g., the U.S., the U.K., Singapore, and Malaysia). However, among all problems, "Insufficient safety staff of EM origin" and "Personal characteristics of EMWs" have not been highlighted by existing literature. These two safety and health problems have been regarded as key problems by interviewees and ranked as the third and seventh most severe problems by experts, respectively.

It has been found that the most severe safety and health problems encountered by EM construction were "Insufficient safety materials in their native language" and "Insufficient safety training in their native language." These two subcategories mainly refer to the limited language ability of employers to deliver safety information in the EM native languages, uncertain translation quality of safety promotion information, and difficulties in grasping of the degree of EMWs' understanding of safety information. Safety information is mainly prepared and disseminated in Cantonese on construction sites of Hong Kong. Safety materials and trainings in English are very limited. In addition, compared to English-speaking jurisdictions, Hong Kong has additional difficulties in disseminating safety information to EMWs in their native languages. Most EMWs in Hong Kong can only speak simple Cantonese and English and have difficulty in reading and writing both Cantonese and English. Some translation companies only provide translation services from English to EM languages and are unable to translate Cantonese into EM languages. Therefore, translating Cantonese into EM languages needs to firstly be translated from Cantonese to English, and then from English to EM languages, which may result in information loss and distortion

"Insufficient safety staff of EM origin", which was ranked as the third most severe safety and health problem, has seldom been identified by other researchers. The interviewees in this study highlighted the advantages of employing EM safety staff. Although recruiting translators or interpreters is beneficial for alleviating communication barriers of EMWs, the qualities of the translations are questionable as verifying if the translators understand the technical jargon used in construction and translate correctly into the EM languages are difficult. Furthermore, extra cost and time are required to recruit translators. An EM safety staff member can act as a bridge among the EMWs, local workers, and senior management. However, there are very few EM safety staff in the Hong Kong construction industry. Thus, motivating EMWs to attend relevant trainings and obtain proper qualifications to become safety officers is necessary.

"Safety communication problems of EMWs" was ranked as the second most severe problem in the first round and the fourth in the second round. It can affect EMWs' safety performance in many ways, such as an inability to convey their complaints and concerns to their management, affecting their interaction with co-workers, increasing the risks of them and their co-workers, and delaying their treatment or causing mistreatment when injury occurs. The safety communication problem of EMWs has been commonly identified by other researchers. For instance, Santoso (2009) revealed that EMWs had difficulties in understanding specific instructions from the foremen. Nearly half of EMWs surveyed in the study of Trajkovski and Loosemore (2006) misinterpreted work-related requirements and instructions due to their poor language ability and even more than half of EMWs had made mistakes. Dainty et al. (2007b) regarded that the poor language proficiency of EMWs would put themselves and their co-workers in danger.

"Lack of government support to enhance EMWs' safety performance" and "Lack of safety culture and management commitment for EMWs" were ranked as the fifth and sixth severe safety and health problem faced by EMWs. "Lack of government support to enhance EMWs' safety performance" refers to the lack of effective propaganda, insufficient safety training, and insufficient Chinese language courses. "Lack of safety culture and management commitment for EMWs" indicates insufficient PPE, inability to identify the special characteristics of EMWs (i.e., language ability, and religious background), the lack of a safety promotion program for EMWs, and unfair welfare. The incomplete safety management system of government and contractors would result in the unsafe behaviour of EMWs. These safety and health problems at the government and corporate levels are even more serious than some safety and health problems at the individual level. Similarly, safety management systems are not developed to suit the specific needs of EMWs, which result in the unsafe behaviours of these workers.

8.3 CRITICAL SAFETY COMMUNICATION FACTORS OF EMS

Understanding the factors contributing to the effective communication of EMWs in construction projects is vital to improve their safety and health performance. The current study presents the critical safety communication factors perceived by EM construction workers. These factors were identified from a systemic literature review, semi-structured interviews, and ranked based on the perceptions of EMWs. According to the results of the mean score technique and EFA, three groups involving 18 critical safety communication factors for EMs were determined, including worker related factors, management related factors, and organisation related factors. These 18 critical SC factors explained 71.23% of the total variance. These three groups of factors were considered to be beneficial for EMs for improvement in the effectiveness of communication. Among these 18 critical factors, only seven factors were highlighted by the interviewees, indicating that the management staff involved in this study still lacked sufficient understanding of safety communication problems of EM construction workers.

8.3.1 Group 1: Worker-related safety communication factors for EMs (WFEM)

This group highlight the importance of workers in the safety communication. It explained the highest variance (53.935). There were six critical factors: "Adequacy of language ability of workers" (D5), "Having work experience in construction" (D4), "Personality type of workers" (D6), "Good emotional state of employees" (D9), "Providing feedback from workers to management" (D10), and "Workers' understanding of culture in host country" (D1). Among these six factors, D5 fell in Quadrant I, D6 and D4 in Quadrant II, D1 in Quadrant III, and D9 and D10 in Quadrant IV. The importance of adequacy of language ability of workers (D5), good emotional state of employees (D9), and providing feedback from workers to management (D10) were also highlighted by the interviewees.

"Adequacy of language ability of workers" (D5) had the most explanatory power and importance in this group WFEM (β = 0.924, M = 4.13), according the results of this study (Figure 5.8). Sufficient language ability of EMs in the predominant languages used onsite was of great importance for the effectiveness of safety communication with local workers and management staff. Some EM construction workers could only grasp rudimentary local languages, while the others were unable to communicate in local languages (Miller et al., 2000; Guldenmund et al., 2013; Chan et al., 2017). The low level of proficiency and literacy is detrimental to their understanding of safety and health information and hinders local management in conveying safety related instructions in a timely manner (Huczynski and Buchanan, 2001; Guldenmund et al., 2013). Interviewee C stated that management had difficulty giving instant and on the spot warnings to EMWs due to the language barriers.

"Personality characteristics of workers" (D6) had high importance but relatively low explanatory power ($\beta = 0.779$, $M = 4.07$) (see Figure 5.8). Personality refers to "a pattern of relatively permanent traits and unique characteristics that give both consistency and individuality to a person's behaviour" (Feist and Feist, 2006, p. 4). Personality characteristics are one of the fundamental causes in explaining communication behaviours (Leung and Bond, 2001). For instance, in the model developed by MacIntyre (1994), willingness to communicate is predicted by a combination of a higher level of communicative competence and lower level of communication apprehension. Additionally, their model highlighted the role of personality characteristics. They revealed that introversion could affect both communicative competence and communication apprehension, and self-esteem has an impact on the communication apprehension (MacIntyre and Charos, 1996). Burleson and Caplan (1998) found that cognitive complexity is related to the ability to understand other's messages and have effective interactions. Weaver (2005) and de Vries et al. (2013) demonstrated that there are connections between personality and communication style. However, very little evidence regarding the effects of personality on communication outcomes can be found in the context of construction management.

"Having work experience in construction" (D4) also had high importance but relative low explanatory power ($\beta = 0.779$, $M = 4.07$) (see Figure 5.8). Hare et al. (2013) suggested that the length of work experience of construction workers affects the understanding of safety materials. They found that those who are more experienced perform better in identifying safety images compared with those who are less experienced. Thus, it can be assumed that EMWs who have more work experience in construction are likely to attend more safety training and activities, which is helpful for them to improve their ability to interpret safety information.

"Good emotional state of workers" (D9) fell into the fourth quadrant and had high explanatory power but relatively low importance in the group of WFEM ($\beta = 0.885$, $M = 3.96$) (see Figure 5.8). Dainty et al. (2007a) stated that psychological stress and tension are strongly related to the employee's ability to deal with and respond to the relevant information and messages received. Construction workers who are positioned at the bottom of the organisation are regarded as more susceptible to emotional stress compared to managerial staff (Leung et al., 2012). EM construction workers are more likely to face more stress and anxiety, as they often have stress provoked by being in a new cultural and physical environment, as well as stresses of poor living conditions coupled with anxiety over absent family and the struggle to financially maintain that family from a physical and emotional distance. In addition, intercultural studies have highlighted that interaction with others from different cultures often leads to stress and anxiety (Ulrey and Amason, 2001). These stresses may impinge on the effectiveness of the safety communication of EMs.

"Providing feedback from workers to management" (D10) was another factor in fourth quadrant and had high explanatory power but relatively low importance in the group of WFEM (β = 0.856, M = 3.99) (see Figure 5.8). According to communication theory, feedback is a key element of theoretical models of communication proposed by previous researchers, such as Feldberg (1975), McHugh and Thomson (1990), and Dainty et al. (2007a). The reasons why employees are reluctant to provide feedback or raise important job-related or organisation-related issues to their management above them in the organisational hierarchy were found to include fear of being regarded negatively be management, damaged relationships, and retaliation (Milliken et al., 2003). If there is no feedback between the sender and the receiver, it is hard to determine whether the meaning of a message is conveyed and shared accurately. Interviewees L and N revealed that there was a lack of feedback from EMWs, resulting in management not knowing the level of EMWs' understanding of safety and health procedures, rules, and regulations. The reason may be that EMWs tend to protect themselves and are afraid of losing their jobs.

"Workers' understanding of culture in host country" (D1) fell into the third quadrant and had a relatively low importance and explanatory power compared with the other variables in this group (β = 0.788, M = 3.98). Culture is commonly defined as "the notion of shared beliefs and values that guide behaviour in social settings and distinguish groups of people from one another" (Casey et al., 2015, p. 175). It significantly affects the interaction between communicators (Hybels and Weaver, 2004; Xie et al., 2009), the way people communicate, and the way people perceive communication (Loosemore and Lee, 2002). Lack of understanding of cultural differences is one of the barriers to effective communication (Sheldrick-Ross and Dewdney, 1998). Hare et al. (2013) stated that cultural differences could affect the ability of construction workers to understand safety related materials and their communication ability.

8.3.2 Group 2: Management staff-related safety communication factors for EMs (MFEM)

The management staff-related factors encapsulated seven factors: "High quality of supervisor-subordinate relationship" (D24), "Building trust within the team" (D21), "Relevance and accuracy of safety information provided by safety staff" (D22), "Avoiding using too much technical terminology and difficult words" (D13), "Careful and active listening to workers" (D17), "Appropriateness of communication style of leader" (D12), and "Cultural sensitivity and competence of management" (D23). This group accounted for 9.564% of the total variance explained among all SC factors. Factor D24 was in Quadrant I, D22 and D21 were in Quadrant II, D13, D12, and D17 were in Quadrant III, and D4 was in Quadrant IV. Notably, only one factor (D12) was identified by the interviewees as important for the communication of EMs. This may be explained by management staff perhaps not realising the significant roles management play in improving the effectiveness of EMs.

"High quality of supervisor-subordinate relationship" (D24) had the most explanatory power and importance in the group of MFEM (β = 0.788, M = 3.98). The quality of the supervisor-subordinate relationship is connected to various individual and organisational outcomes, such as communication quality, job satisfaction and commitment to the organisation (Sias, 2005; Abu Bakar et al., 2010). Research on supervisor-subordinate relationships has suggested that the subordinates in low and high quality relationships engage in different communication with their supervisors, and the quality of the relationship influences not only how subordinates decide to communicate with their supervisor but also what they decide to communicate (Krone, 1992; Kassing, 2000; Abu Bakar et al., 2010). A poor relationship with management may lead to low interaction and mutual misunderstanding and inhibit workers from reporting hazardous and risky situations; while in high quality relationships, workers and management are more likely to communicate openly (Sias, 2005). Thus, building a high-quality supervisor-subordinate relationship will facilitate EMWs to communicate directly and openly, share their opinions, and provide positive or even contradictory feedback.

"Relevance and accuracy of safety information provided by safety staff" (D22) fell into Quadrant II and had high importance but a relatively low explanatory power in the group of MFEM ($\beta = 0.739$, $M = 4.04$). The quality of information is also an important aspect of communication, including timeliness, accuracy, and relevance. As for relevance, Zaremba (2006) asserted that to make the communication effective, the message should be considered as important and relevant by communicators, otherwise the message could be possibly abandoned. Accuracy is another criteria of information, which is related to reliability of the message. Allen (1996) identified that information quality had a positive connection with the level of satisfaction of workers in communication with immediate supervisors.

"Building trust within the team" (D21) also fell into Quadrant II and had high importance but relatively low explanatory power in the group of MFEM ($\beta = 0.751$, $M = 3.95$). Rogers (1995, p. 16) highlighted trust as the fundamental feature in the ideal workplace, and defined trust as "confidence that others' actions are consistent with their words, that those people with whom you work are concerned about your welfare and interests apart from what you can do for them, that the skills you have developed are respected and valued by your co-workers and the larger organizations and that who you are and what you believe truly matter in the workplace". However, distrust and suspicion often exist among individuals from different cultural backgrounds. It is essential to build trust between EMWs and their local counterparts and management within a multicultural team. Drawn upon the interviews with professionals in Kenya and the U.K., Ochieng and Price (2010) suggested that trust is an important element in effective cross-cultural communication in multicultural construction project teams. They found that a high level of trust within a team can fully integrate the multicultural team and lead to open and honest communication among team members. It is reasonable to believe that EMWs' trust in their management or their co-workers can fuel and boost them to cooperate and express themselves openly.

"Cultural sensitivity and competence of management" (D23) is the only factor that fell into Quadrant IV and had high explanatory power but relatively low importance in the group of MFEM (β = 0.829, M = 3.93). It is essential for local management to improve their cultural sensitivity and competence in order to meet the challenge posed by a more culturally diverse workforce in the construction industry resulting from growing globalisation. According to Hofstede's (2003) research model, culture can be divided into five dimensions: power distance, individualism-collectivism, masculinity-femininity, uncertainty avoidance, and long-term orientation, which is one of the most wildly used and influential frameworks (Minkov and Hofstede, 2011; Casey et al., 2015). Employees from different cultural backgrounds may have different communication effectiveness in various aspects (Loosemore and Lee, 2002; Xie et al., 2009). For instance, Xie et al. (2009) found that high context people communicate more effectively during nonverbal communication than low context people, whereas low context people communicate more effectively in verbal communication than high context people. They also demonstrated that power distance influences the efficiency of communication interaction. Thus, when communicating with EM construction workers, management should not rely on their own frame of reference, beliefs, or values. Competent management should be sensitive and respond to the cultural discrepancies of construction workers and make adjustments for their behaviour to meet cultural expectations (Hackman and Johnson, 2013).

"Avoiding using too much technical terminology and difficult words" (D13) fell into Quadrant III and had relatively low explanatory power and importance in the group of MFEM (β = 0.744, M = 3.92). Management may unconsciously use too much technical terminology, which is difficult for EMs to understand, considering that some EMs can only grasp rudimentary local language or do not know the language at all. It has been found that many EM construction workers have difficulty comprehending the safety instructions from safety supervisors and safety work procedures (Dai and Goodrum, 2010; Chan et al., 2017). Although it is almost impossible for local management to communicate with EMs in their native languages, safety management should take into consideration the limited language ability of migrant workers and attempt to use more simple and easy-to-understand words when communicating with EMs.

"Appropriateness of communication style of management" (D12) also fell into Quadrant III and had relatively low explanatory power and importance in the group of MFEM (β = 0.762, M = 3.90). The communication style refers to "the way one verbally and paraverbally interacts to signal how literal meaning should be taken, interpreted, filtered, or understood" (Norton, 1978, p. 99). Leader communication style is how leaders send verbal, nonverbal and paravebal signals to subordinates. Norton (1978) categorised communication style into ten types: dominant, dramatic, contentious, animated, impression-leaving, relaxed, attentive, open, friendly, and precise. Heffner (1997) classified communication styles into aggressive, passive, and assertive (Newbold, 1997). Management enact various communication styles onsite. Some management communication styles can affect the level of understanding of the safety related information of EMs. For instance, in a passive communication style, management may not convey and explain the safety information explicitly, while in an aggressive communication style, management tends to express their instructions and opinions in a way that may ignore the needs, feelings, and rights of workers (Dasgupta et al., 2012). In an assertive communication style, management is more straightforward and accurate, respects the needs of workers, and has more skills to handle misunderstandings, which can establish the trust and facilitate workers' understanding of information (Tschannen-Moran and Hoy, 2000; Moye and Henkin, 2006). It is necessary to investigate which kind of management communication style is suitable for EMs to better comprehend safety information.

"Active and careful listening to workers" (D17) was another factor in Quadrant III and had relatively low explanatory power and importance in the group of MFEM (β = 0.745, M = 3.90). Listening refers to active selection, a combination process of received data, efficient hearing, and listening style (Pearce et al., 2003). Active listening was popularised by Rogers and Farson (1979) and has been advocated in many disciplines, such as education (McNaughton et al., 2008) and health care (Duhamel and Talbot, 2004). The active listening skill is one of the most valued communication skills and an important indicator of good leaders (Darling and Beebe, 2007; McCuddy and Cavin, 2008), and an critical aspect for managing cross-culture (Wills and Barham, 1994; Chang and Tharenou, 2004; Toor and Ogunlana, 2008). Poor listening has been regarded as one of the barriers to effective communication in the construction industry (Ejohwomu et al., 2017). The receiver needs to be aware of all of the components conveyed by the sender, such as verbal content, nonverbal content, and feeling. In a multicultural workgroup, management's ability to listen carefully and actively to what employees express, such as work practice, needs, concerns, and their opinions on various issues is of great importance due to potential misunderstanding and misrepresentation (Chang and Tharenou, 2004).

8.3.3 Group 3: Organisation-related safety communication factors for EMs (OFEM)

The third group is organisation-related safety communication factors for EMs and accounted for 7.731% of variance explained among all factors. It comprised five factors related to organisations: "Organisational support and concern" (D33), "No much time pressure for completion of the project" (D34), "Application of pictorial or visual safety materials" (D27), "Adequacy and appropriateness of safety training" (D31), and "Employment of safety staff from workers' origin country" (D26). Among these factors, D33, D34, and D27 were in the first Quadrant, and the other two factors were in Quadrant III. Only one factor was identified by the interviewees (i.e., application of pictorial or visual safety materials), which may be explained as management staff not understanding the ways in which the organisation could effectively improve the safety communication of EMs.

"Organisational support and concern" (D33) fell into Quadrant I and was considered one of the most explanatory and important factors in the group of OFEM (β = 0.858, M = 3.93). Employee's perceptions of organisational support and concern is a vital antecedent for safety communication. When employees perceive that the organisation is actively concerned about and supports them, they will be willing and feel free to raise safety issues and believe that raising issues will not lead to negative consequences for themselves. Hofmann and Morgeson (1999) demonstrated that perceived organisation support was significantly correlated to safety communication. However, the predictive role of organisational support in upward safety communication was not found in the study by Kath et al. (2010). In the current study, EM construction workers perceived that organisation support and concern were critical for their safety communication. It is of great significance for organisations in the construction industry to actively demonstrate and convey their support to their EM employees.

"No much time pressure for completion of the project" (D34) also fell into Quadrant I and was considered one of the most explanatory and important factors in the group of OFEM (β = 0.819, M = 3.97). Many construction projects are awarded to deliver in a shorter period, resulting in time pressure to deliver projects as soon as possible. When workers and management perform under extreme time pressure for the completion of a project, their communication patterns may be influenced, as time pressure is regarded as one of the sources of stress faced by employees. Kelly and McGrath (1985) investigated the communication patterns among team members under different levels of time pressure and concluded that as the level of time pressure increased the participation of crew members was more disproportionate and communication time was distributed unevenly. Additionally, evidence has been found to support that stressful environmental conditions could lead to a more decentralised pattern of communication (Brown and Miller, 2000).

"Application of visual or pictorial safety materials" (D27) was another factor that fell into Quadrant I in the group of OFEM (β = 0.862, M = 3.91). Visual safety materials, such as visual images, DVDs, and leaflets have been increasingly used on construction sites, which can make hazard communication more effective. However, some visual safety material may not be feasible to communicate safety messages, hazards, and controls to EMWs. Bust et al. (2008) suggested that the experiential knowledge and cultural narratives used by workers need be investigated to identify the visual narratives that are suitable and meaningful for construction workers on multicultural sites. The results of Hare et al. (2012) show that pictorial aids can communicate simple hazards and controls to EM construction workers, but they also emphasised that the role of pictorial aids is only a supplement to the existing communication approaches rather than replacement.

"Adequacy and appropriateness of safety training" (D31) fell into Quadrant III and was considered less explanatory and important in the group of OFEM (β = 0.731, M = 3.87). Some EM construction workers (e.g., Hispanic workers) believe that one of the reasons they have difficulties in communication is due to a lack of proper safety training (Evia, 2010). Most safety training provided to EM construction workers is either insufficient or inappropriate (O'Connor et al., 2005). The majority of EM workers in the survey of Loosemore and Lee (2002) expressed that safety training in their own languages was more effective. Additionally, Evia (2010) suggested that computers can be useful aids to workplace safety training for EM workers and Lin et al. (2012) stated that 3D simulated virtual job sites could help EM workers to learn in training.

"Employment of safety staff from workers' origin country" (D26) also fell into Quadrant III and was considered less explanatory and important in the group of OFEM ($\beta = 0.717$, $M = 3.80$). Safety officers, supervisors, foremen, and gangers from EM origin countries could be employed to act as bridges between local management and EMs due to the homophily theory that people tend to communicate with others who are similar to themselves, especially the same race and ethnicity (McPherson et al., 2001). This is one of the normal practices adopted by management onsite in the Hong Kong construction industry. For instance, interviewees I, K, M, N, and O mentioned that a ganger and safety supervisor who could speak the EM's native language and local language were the communication bridges between local management and EMWs and played an important role in conveying the messages to EMWs.

8.4 RELATIONSHIPS BETWEEN CRITICAL SAFETY COMMUNICATION FACTORS AND THE SAFETY PERFORMANCE OF EMS

Exploratory factor analysis was used to categorise the determinants of safety performance into two groups (safety motivation and safety knowledge), and indicators of safety performance into two groups (safety compliance and safety participation). Research models were proposed to test the direct effects of critical safety communication factors of EMs on their safety performance (Model 1) and the indirect effects of factors on safety performance via safety knowledge and safety motivation (Model 3). The proposed structural equation models achieved an acceptable level of goodness-of-fit, and all measurement models involved in these three models achieved an acceptable level of validity and reliability. The direct relationship between critical safety communication factors of EMs and safety performance, which was significant in Model 1, became insignificant in the Model 3, where safety motivation and safety knowledge were entered as the mediators, indicating that safety motivation and safety knowledge completely mediated the relationships between critical safety communication factors and safety performance. The mediation model (Model 3) explained 55% of the variance in safety compliance and 61% of the variance in safety participation, while the basic model (Model 1) accounted for only 41% of the variance in safety compliance and 45% of the variance in safety participation. The increased percentage of variance explained in the mediation model through the inclusion of safety motivation and safety knowledge in the mediation model supported the great effects of safety motivation and safety knowledge on safety performance.

Worker-related safety communication factors of EMs (WFEM) were found to directly influence the safety compliance and safety participation of EMWs. Additionally, the effects of WFEM on the safety compliance and safety participation of EMs were completely mediated by safety knowledge and safety motivation. “Adequacy of language ability of workers”, “personality characteristics of workers”, “having work experience in construction”, “good emotional state of workers”, “providing feedback from worker to management”, and “works’ understanding of culture in host country” which are critical for the effectiveness of safety communication of EMs, can improve their level of safety knowledge and safety motivation, leading to the increase of safety compliance and safety participation of EMs. Such results are consistent with the findings of Cox and Ferguson (1994), Cellar et al. (2001), Siu et al. (2004), Henning et al. (2009), Kaskutas et al. (2013), and Seo et al. (2015). For instance, Cox and Ferguson (1994) revealed that job stress had negative effects on safety behaviour. Siu et al. (2004) found that psychological strains affect the safety performance of workers. Cellar et al. (2001) and Henning et al. (2009) found that personal characteristics had direct effects on the safety behaviours of employees and Seo et al. (2015) revealed that personal characteristics indirectly influenced safety behaviours. Kaskutas et al. (2013) revealed that inexperienced construction workers are subjected to fall hazards. Traditionally, it is believed that the language ability of EMs is very important for their safety. The current study also highlighted that the efforts to relieve and resolve cultural and emotional problems are essential to reduce unsafe behaviours of EM construction workers. In addition, understanding of the EM construction workers' perceptions about communication factors should be included in the training of safety management.

Management staff-related safety communication factors of EMs were found to affect the safety compliance and safety participation of EMs directly and indirectly. This indicates that the combination of "High quality of supervisor-subordinate relationship", "Relevance and accuracy of safety information provided by safety staff", "Building trust within the team, cultural sensitivity and competence of management", "Avoiding using too much technical terminology and difficult words", "Appropriateness of communication style of management", and "Active and careful listening to workers" could enhance the safety compliance and safety participation of EMs. In addition, these factors could also improve the safety knowledge and safety motivation of EMs, which in turn increase safety compliance and safety participation. Supervisor communication practices have been demonstrated to influence various outcomes of workers in many fields. For instance, Johlke and Duhan (2000) found that there were connections between the frequency of supervisor-employee communication and employee's job satisfaction, as well as between bidirectional communication and employee's job performance. However, this finding is inconsistent with the argument of Michael et al. (2006), who found that supervisors' relationships and communication with subordinates had little direct effect on workers' self-reported safety-related events in wood manufacturers. They believed that safety communication between supervisors and employees was insufficient to reduce the injuries and accidents. In the context of construction, the results of the current study are partly consistent with the findings of Cigularov et al. (2010), Kines et al. (2010), and Kaskutas et al. (2013). Kines et al. (2010) found that coaching construction site foremen regarding verbal safety communication with construction workers significantly influenced workers' safety performance. Kaskutas et al. (2013) found that the majority of residential construction foremen surveyed in their study had never been educated about effective ways to convey safety messages to construction workers and some foremen did not know the correct information to convey. After training foremen about how to deliver safety messages, the frequency and skills of their safety communication with workers increased, leading to a higher level of compliance with fall protection and less unsafe behaviours of workers. However, these studies have primarily focused on the importance of several management-related safety communication factors about safety performance, such as frequency and the appropriateness of messages. Apart from these factors, the current study highlighted the significant roles of the supervisor-subordinate relationship, trust, cultural sensitivity, and competence, and active and careful listening to workers in leading to a high level of supervisor-workers safety communication, which could improve the safety performance of EM construction workers. In order to improve management-related factors, management staff need to enhance their understanding of the communication process and be provided with suitable training.

Thirdly, although the organisation-related safety communication factors of EMs were not found to have direct effects on the safety performance of EMs, they had a significantly indirect effect on safety performance. It is reasonable to believe that the implementation of these safety management practices, which are critical for the safety communication of EMs, will increase the level of safety knowledge and safety motivation of EMs, leading to better safety performance. These findings provide evidence to show that in order to improve the safety performance of EMs, the organisation needs to actively be concerned about and support EMs; monitor and decrease the high level of time pressure; design and adopt visual safety materials, such as visual images, DVDs, and leaflets; design systematic, comprehensive, and suitable safety training programs for EM construction workers, especially for new EM entrants; and employ EM staff to act as communication bridges between local management and EMs. These findings support previous findings from the studies of Mearns and Hope (2005) and Vinodkumar and Bhasi (2010). An earlier study by Mearns and Hope (2005) revealed that higher organisational investment in safety and health related activities resulted in higher compliance of employees with safety requirements and regulations. While Vinodkumar and Bhasi (2010) showed that some safety management practices, such as safety training, could predict safety compliance indirectly via safety motivation.

8.5 COMPARATIVE ANALYSIS OF SAFETY COMMUNICATION FACTORS BETWEEN EMS AND MANAGEMENT STAFF

8.5.1 Overall ranking of SC factors perceived by all management staff

The 36 SC factors for EMs were evaluated from the different perspectives of management staff groups. The chi-square χ^2 values of all management staff and each group of management were all higher than the critical χ^2 value based on the results of Kendall's concordance analysis. It can be concluded that there is strong evidence supporting a significant degree of agreement among all management staff and each group of management staff on the ranking of the importance of SC factors of EMs. This result confirms the validation and consistency of the data collected from management staff for further analysis.

All management staff in the current study ranked "Adequacy of language ability of workers" (D5) as the top SC factor, which was consistent with the perception of EMs that "Adequacy of language ability of workers" (D5) was the top factor for them. This result was also previously revealed and highlighted in many studies regarding the safety of EM construction workers (Loosemore and Lee, 2002; Brunette, 2005; O'Connor et al., 2005; Evia, 2010; Lin et al., 2012). The second and third important SC factors perceived by all management staff were "Adequacy of time when communicating with workers" (D19) and "Appropriateness of communication style of management" (D12), respectively.

For SC factors scored by management staff working as main contractors, the mean values spanned from 3.10 to 3.71, whereas the means values of those rated by management staff working as subcontractors ranged from 3.13 to 3.96. The results show that the management staff from subcontractors rated these SC factors of EMs higher than those from main contractors. It can be interpreted that the management staff from subcontractors considered those SC factors to be more important than the main contractors. The mean values of SC factors rated by management staff in Hong Kong ranged from 3.12 to 3.67, while mean values of SC factors rated by management staff in Australia ranged from 2.75 to 4.10. The span of mean values in the Australian group was larger than that in the Hong Kong group. This may be explained by respondents in Australia having diverse perceptions about the importance of SC factors of EMs. Additionally, the mean values of the experienced group ranged from 3.20 to 3.75, whereas the mean values of the non-experienced group with EMs ranged from 2.60 to 4.07. This indicated that management staff with work experience with EMs regarded these SC factors as important, while those management staff with no work experience with EMs had very diverse perceptions about the importance of SC factors.

Whether there was significant agreement in the rankings of SC factors between the two groups of management staff (i.e., main contractor vs subcontractor, Hong Kong vs Australia, and experienced vs non-experienced) was tested using Spearman rank correlation. The null hypotheses that there was no significant association in the rankings of the SC factors of EMs between two groups of management staff were all rejected. Thus, there is strong evidence to support that there was no significant disagreement between any two groups of management staff in the rankings. This indicates that consensus existed among different groups of management staff regarding the importance of SC factors for EMs.

8.5.2 Ranking differences of SC factors between EMs and management staff

Whether there was consensus in the rankings given by EMs and management staff was evaluated using a Spearman rank correlation test. The null hypotheses that there is no significant correlation on the rankings of SC factors of EMs between EMs and management staff was accepted. This result revealed that there was significant disagreement in the ranking of SC factors between EMs and management. For instance, among the 18 critical SC factors identified by EMs, only eight SC factors were also ranked as critical by management staff. Among 17 critical SC factors for EMs identified by management, nine factors were regarded as not critical by EMs. Only eight SC factors were identified as critical by both EMs and management. This reflects that management staff did not share the same opinions about the relative importance of SC factors of EMs.

In order to obtain a clearer picture of the difference in the mean values of the importance of SC factors between perceptions of EMs and management staff, a *t*-test was conducted.

The results revealed that 22 out of 36 SC factors for EMs were perceived significantly differently by EMs and management staff, all of which were perceived as more important by EMs than by management staff. The factors with the greatest difference between EMs and management were “Cultural sensitivity and competence of management” (D23) (mean difference = 0.715) and “Adequacy of workers’ understanding of culture in host country” (D1) (mean difference = 0.683). The disparities revealed that the management staff were unaware of the significance of culture in the safety communication for EM construction workers.

8.6 COMPARATIVE ANALYSIS OF SAFETY COMMUNICATION FACTORS AMONG EMS AND LOCAL WORKERS

8.6.1 Ranking differences of SC factors between EMs and local workers

As per the perceptions of local construction workers, 18 out of 36 factors were identified as critical for the effectiveness of safety communication of local workers. The three most critical SC factors for local workers were “Adequacy and appropriateness of safety trainings” (D31), “Adequacy and appropriateness of toolbox talks” (D32), and “Adequacy and appropriateness of formal presentation from upper management” (D29), which were the 17th, 28th, and 34th SC factors for EMs. Additionally, the most critical SC factor for EMs “Adequacy of language ability of workers” (D5), “Personality characteristics of workers” (D6), and “Adequacy of workers’ work experience in construction” (D4) were ranked to the 24th, 12th, and 5th SC factors by local construction workers. This indicates that local workers and EMs had extremely different perceptions about most critical SC factors and that the most critical factors identified by one group were perceived as much less important by their counterparts.

In order to test whether there was consensus in the rankings exercise between EMs and local construction workers, a Spearman rank correlation test was carried out. The null hypotheses that there is no significant correlation on the rankings of SC factors between EMs and local workers was accepted. It can be concluded that there was significant disagreement in the ranking of SC factors between EMs and local workers. This reflected that there was a difference in the methods for improving the effectiveness of safety communication of EMs and local workers.

The results of the *t*-test showed that more than two-thirds of the rated 36 SC factors (28 out of 36) had a significant difference in the mean values, as perceived by EMs and local construction workers. Among these factors, EM respondents gave higher ratings on all of 28 factors than the local construction workers. Factors with greatest difference between EMs and management were “Adequacy of workers’ understanding of culture in host country” (D1) (mean difference = 0.943) and “Adequacy of language ability of workers” (D5) (mean difference = 0.914). It can be interpreted that, as native speakers, local construction workers grasped sufficient language ability and understanding of indigenous culture, which are not indispensable for their further improvement of safety communication.

8.6.2 Differences in relationships between SC factors and safety performance in groups of EMs and local workers

The direct and indirect effects of critical SC factors for local workers regarding their safety performance were analysed using structural equation modelling. The SEM results showed that worker-related safety communication factors of local workers (WFL) had no significantly positive direct and indirect effects on their safety performance. This was not in line with the findings of EMs that WFEM could directly and indirectly predict the safety performance of EMs.

Management staff-related SC factors of local workers (MFL) was found to directly predict the safety performance of local workers and had significantly indirect effects on their safety performance via safety knowledge and safety motivation. These results were consistent with the findings regarding EMWs that MFEM had both direct and indirect effects on the safety performance of EMs. This consistency highlighted the importance of management in safety communication and safety performance of both EM and local workers.

Organisation-related SC factors of local workers (OFL) had only direct positive effects on the safety performance of local workers and the indirect effects of OFL on safety performance were not significant. These findings were different from those of EMs, in that OFEM did not directly predict the safety performance of EMs but could affect their safety performance indirectly via safety knowledge and safety motivation.

8.7 SAFETY COMMUNICATION NETWORKS

The language abilities of workers in high performing EM crews were found to be better than those of workers in low performing EM crews. Indeed, previous research has suggested that the poor language proficiency of EMWs has a negative impact on their safety. Trajkovski and Loosemore (2006) stated that due to poor language ability, many EMWs have misunderstood safety instructions and made some mistakes. Additionally, they have difficulty in open and proactive communication with their local co-workers and safety supervisors, such as being unable to report risky situations, reject unsafe tasks, express their worry, and fully comprehend the risks of some works (Loosemore and Lee, 2002; Goodrum and Dai, 2005; Guldenmund et al., 2013). Although the language abilities of EMWs in predominant languages in some crews were low, translators or interpreters were rarely used in EM crews. This result coincides with the research findings obtained from the semi-structured interviews and the Delphi survey conducted with safety professionals in Hong Kong in Chapter 4 that recruiting translators was ranked as the least important strategy for improving the safety performance of EMWs. This implies that the usage of translators is still an unpopular and unvalued measure in the Hong Kong construction industry, although its importance has been highlighted by many researchers, such as Bust et al. (2008) and Tutt et al. (2011).

The network densities of high performing EM crews were found to be higher than those of low performing EM crews. This finding is consistent with the existing findings of Alsamadani et al. (2013a) and Albert and Hallowell (2014), who found crews with denser networks performed better than those with sparse networks. It is worth noting that the network densities of EMWs crews revealed in this study were relatively low compared with those of construction crews revealed by other studies. For instance, the average network densities for all-male crews and mixed-gender crews investigated in the study of Allison and Kaminsky (2017) were 0.82 and 0.79 respectively, and the densities of construction workers calculated by Albert and Hallowell (2014) ranged from 0.32 to 0.88.

The high performing crews show higher values for both arc and dyad reciprocity than low performing crews (Finding 3). The safety communication in low performing crews was not reciprocated to a great extent, demonstrating a hierarchical structure in the safety communication network where the majority of crew members seek safety information from particular individuals.

Management (e.g., safety officer, supervisor, foreman, and ganger) were identified as the key sources of safety information within EM crews through visual analysis of the sociogram and the calculation of degree (Finding 4). They played significant roles in providing safety information to EMs in crews. This is partly consistent with the findings of Alsamadani et al. (2013b), where management was found to play a key role in the exchange of safety information in terms of both providing and receiving safety information. However, in the current study, management played an extremely important role in providing safety information instead of receiving safety information.

Among all management staff in EM crews, both local and EM management played the same effective roles in the provision of safety information to workers; however, EM management tended to receive much more safety information than local management from EMWs (Finding 5). This can possibly be explained by the homophily theory, that people prefer to communicate with other people who are similar to themselves (Katz et al., 2005). The homophily in race and ethnicity was revealed to generate the biggest divides, followed by age, religion, education, and gender (McPherson et al., 2001). EMWs are more likely to feel free to communicate openly with management from their origin countries.

There was no significant difference in the centrality measures of workers in EM crews by marital status, tenure, experience, or time of training. This finding is contrary to the assumption that long-time, experienced, and well-trained EMWs are more likely to be in central positions of EM crews.

Some centrality measures of workers in EM crews varied significantly with age, educational level, priority of safety, and language ability. Firstly, significant differences in out-degree, in-degree, out-closeness, and in-closeness among different ages of EMWs were found. The youngest EMWs had the highest degree centrality and closeness centrality, followed by the second youngest group (i.e., 21 to 30 years). This finding coincides with the study of Alsamadani et al. (2013b), where workers under 25 years old (youngest group in their sample) had the highest values of centrality.

Significant differences were found in in-degree and in-closeness by educational levels of EMWs (Finding 8). Workers with primary education had the highest in-degree and in-closeness, indicating they received the most safety information compared with other groups. It was not expected that workers who received below primary education would be ranked as the fourth in in-degree and in-closeness among the five groups, as it was assumed that workers who are not well educated should receive more safety information from their co-workers and management.

EMWs tend to be more active in the exchange of safety information if they perceive that the organisation values their safety (Finding 9). This was suggested by the results showing that the out-degree, in-degree, out-closeness, and in-closeness significantly differed with the priority of safety. The higher priority of safety that was instructed by seniors to EMWs, the higher out-degree, in-degree, out-closeness and in-closeness they had in crew networks. This may be explained by the social exchange theory that highly perceived organisational support will promote the safety communication of workers. If workers perceive that their organisation values the safety of their employees, they will feel that their safety related concerns are cared for by the organisation, and thus be more willing to communicate with management and workers about safety related issues.

Trilingual and bilingual EMWs played a more significant role in safety communication within EM crews than monolingual EMWs (Finding 10). A total of 18 EMWs investigated in this study were trilingual, namely their own native language (i.e., Urdu or Nepali), and the two predominant languages used on a construction site (i.e., English and Cantonese). More than half of the EMWs (N = 35) expressed that they were bilingual, namely their native language and one predominant language (i.e., English or Cantonese). The remaining six EMWs were monolingual (i.e., Nepali or Urdu), and could not understand English or Cantonese at all. There were significant differences among the different language abilities of EMWs in their out-degree, in-degree, out-closeness, and in-closeness. Trilingual EMWs showed the highest degree centrality and closeness centrality, followed by bilingual workers. Monolingual workers had the lowest score of out-degree, implying that they seldom provided safety information to other crew members. Apart from out-degree, the in-degree of monolingual workers was also the lowest, indicating that they received the least safety information from others.

8.8 CHAPTER SUMMARY

This chapter discussed the research findings from Chapters 4, 5, 6, and 7, and integrated the findings derived from the interviews, Delphi survey, safety communication factors questionnaires survey, and safety communication network survey with theories and the existing literature. The implications of the safety findings on EM construction workers were also discussed.

Chapter 9: Conclusions

9.1 INTRODUCTION

This chapter concludes the research findings of the seven objectives in this study, draws the implications of the findings, and highlights the significance and limitations of the research and directions for future study.

9.2 SUMMARY OF THE MAJOR FINDINGS

The current study aimed to improve the safety communication of EMs in the construction industry. This was achieved through seven objectives: (1) identify and evaluate the safety and health problems of EMs, (2) identify the critical safety communication factors of EMs, (3) explore the relationship between safety communication factors and safety performance of EMs, (4) undertake a comparative analysis of the safety communication factors among EMs, management, and local workers, (5) build the predominant safety communication structures of EMs, (6) evaluate the safety communication structures of EMs, and (7) investigate the relationship between the safety communication structures and safety performance of EMs. The research results from all seven objectives were presented in Chapters 4 to 7, and the discussed in Chapter 8. The major research findings of the seven objectives are summarised in Figure 9.1 and the following sub-sections.

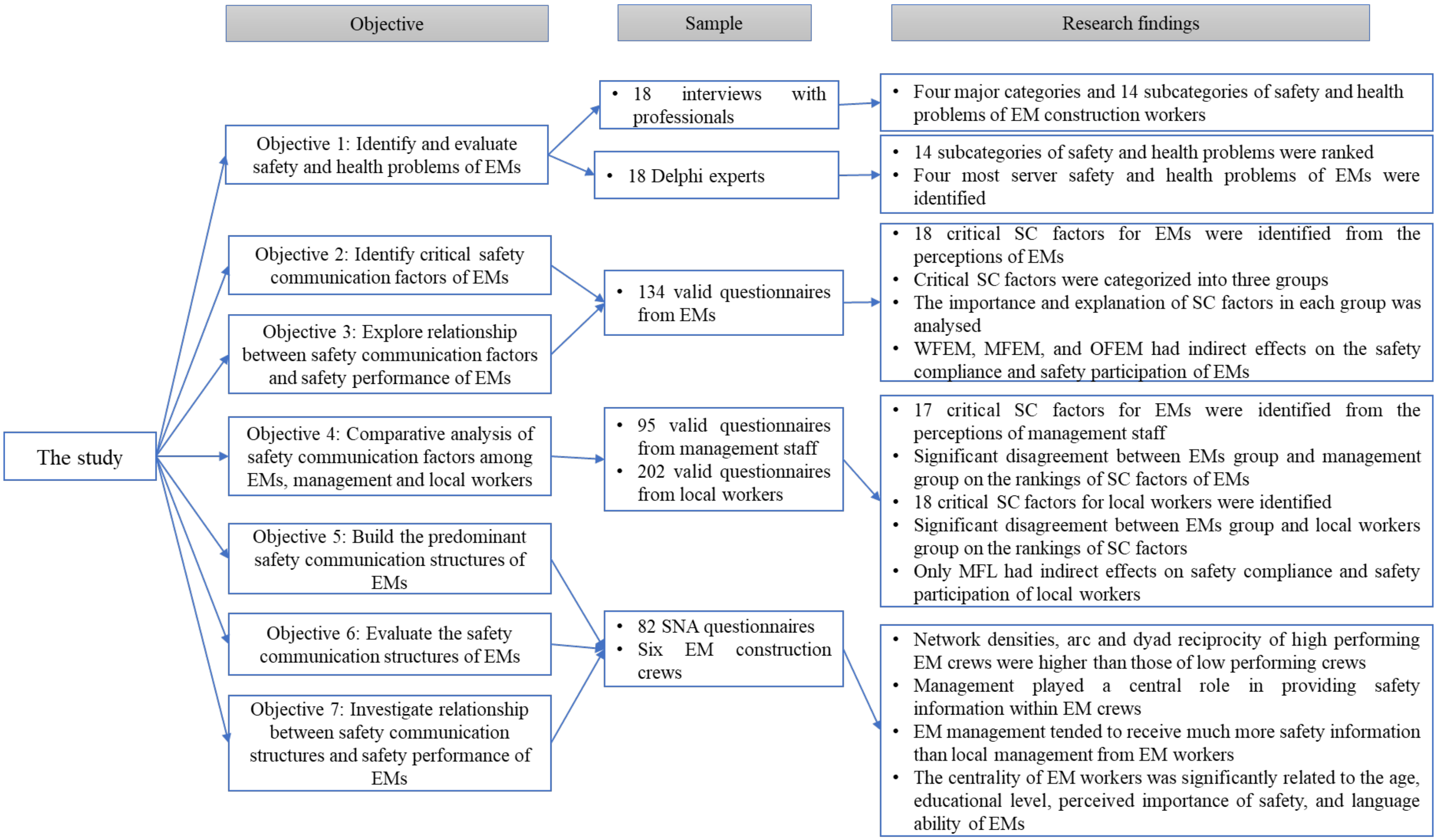

Figure 9.1 The summary of research findings for each objective in this study

9.2.1 Safety and health problems of EMs

A total of 14 subcategories and four categories of safety and health problems were first identified through a comprehensive literature review along with face-to-face semi-structured interviews, and then ranked using the Delphi method with 18 invited experts to achieve the Objective 1. The four main categories of safety and health problems were as follows:

- C1. Insufficient organisational interventions/strategies to support EMWs
- C2. Insufficient government support for EMWs
- C3. Language and communication barriers of EMWs
- C4. Low skill level and safety awareness of EMWs

Among the 14 subcategories, the most four severe safety problems of EM construction workers were found to included "Lack of safety materials in EM native language", "Lack of safety training in EM native language", "Insufficient safety staff of EM origin", and "Safety communication problems of EMWs". Compared with local workers, EMWs require more safety resources to improve their safety knowledge and performance. Safety promotion materials should not only be translated into their native languages, but also propagated to them. Safety staff from the EM's origin, such as supervisors, officers, or trainers are suggested to be recruited in order to avoid distorting and losing safety messages and to communicate the safety information to EM frontline workers to the greatest extent. Apart from lack of suitable safety resources for EMs, the safety problems of EM construction workers were regarded as very critical to the safety of EMs, as revealed by the interviewees. In addition, safety and health problems at the corporate and governmental levels are also worthy of attention.

9.2.2 Critical safety communication factors for EMs

This study designed and validated an instrument to evaluate the safety communication factors for construction workers based on a comprehensive literature review, semi-structured interviews, and expert evaluation. To achieve Objective 2, the data were collected from EMs in the Hong Kong and Australian construction industries. With the help of the mean score technique, 18 out of 36 factors were identified as critical safety communication factors from the perception of EM construction workers. “Adequacy of language ability of workers” (D5), “Personality characteristics of workers” (D6), and “Adequacy of workers’ work experience in construction” (D4) were ranked as the top three important safety communication factors for EMs. “Adequacy and appropriateness of formal presentation from upper management” (D29), “Appropriateness of physical environment” (D36), and “No drinking habits of workers” (D8) were found to be the three least important factors for EMs. In addition, through exploratory factor analysis, the 18 critical factors of EMs were categorised into three groups as follows:

- Worker-related safety communication factors for EMs (WFEM)
- Management staff-related safety communication factors for EMs (MFEM)
- Organisation-related safety communication factors for EMs (OFEM)

9.2.3 Relationships between safety communication factors and safety performance of EMs

Three theoretical research models encapsulating the relationships among safety communication factors, safety knowledge, safety motivation, safety participation, and safety compliance were evaluated based on the data collected from EMs in the Hong Kong and Australian construction industry.

WFEM had significantly positive direct effects on the safety compliance and safety participation of EMs. WFEM also had significantly positive indirect effects on the safety compliance and participation of EMs via safety knowledge and safety motivation. Safety knowledge and safety motivation were two complete mediators between WFEM and safety compliance.

MFEM could directly predict the safety compliance and safety participation of EMs. The positive indirect effects of MFEM on safety compliance and safety participation via safety knowledge and safety motivation were also found to be significant, and safety knowledge and safety motivation completely mediated the relationships between MFEM on safety compliance and safety participation of EMs.

The direct effects of OFEM on safety compliance and safety participation of EMs were not significant. OFEM only had indirect effects on safety compliance and safety participation of EMs.

9.2.4 Comparative analysis of safety communication factors among EMs, management staff and local workers

The first comparative analysis investigated the difference in the perceptions about the safety communication factors of EMs from the perspective of EMs and management staff. A total of 17 factors were regarded by management staff to be critical for the effective safety communication of EMs. “Adequacy of language ability of workers”, “Adequacy of time when communicating with workers”, “Appropriateness of communication style of management”, and “Appropriateness of communication channel adopted to convey safety information” were perceived as the most four significant safety communication factors for EMs by all management staff. There was a significant degree of agreement among all management staff in the rankings of the importance of SC factors for EMs. Additionally, no significant disagreement was found between any two groups of management staff in the rankings. However, there was strong significant disagreement between EMs and management staff in the rankings of importance of SC factors for EMs. Twenty-two out of 36 SC factors were perceived to be significantly different by EMs and management staff, all of which were perceived as more important by EMs than by management staff.

The second comparative analysis explored the difference in the perceptions of safety communication factors from the perspective of EMs and local construction workers. Local construction workers perceived that 18 out of 36 factors as critical for their effectiveness of safety communication and the three most critical SC factors for them were “Adequacy and appropriateness of safety trainings” (D31), “Adequacy and appropriateness of toolbox talks” (D32), and “Adequacy and appropriateness of formal presentation from upper management” (D29). There was significant disagreement in the rankings of SC factors between EMs and local workers. Twenty-eight out of 36 had a significant difference in the mean values as perceived by EMs and local construction workers, all of which were perceived as more important by EMs than by local workers. Unlike the direct effects of WFEM on the safety performance of EMs, WFL was found to have no significant effects on the safety performance of local workers. MFL was found to have both direct and indirect effects on the safety performance of local workers, which was similar to that MFEM directly and indirectly predicted the safety performance of EMs. OFL was only found to directly affect the safety performance of local workers, which was inconsistent with OFEM indirectly affecting the safety performance of EMs.

9.2.5 Safety communication networks of EMs

Recognising that there was insufficient investigation of safety communication networks within EM crews, Objectives 5, 6, and 7 sought to model safety communication networks of EM crews using a social network analysis approach, evaluate the safety communications structures, and examine their relationships with personal attributes and safety experience of EMWs.

The findings suggest that the proportion of EMWs who were fluent in indigenous languages had an association with the safety performance of EM crews. Encouraging EM construction workers to improve their proficiency in indigenous languages is necessary to improving their safety performance. A safety communication network with high density and reciprocity was found to be associated with achieving the safety success of EM crews. However, the network densities of EM crews in the present study were much lower compared to construction crews in previous studies. In light of this, open and frequent communication between EMWs and supervisors and among workers needs to be cultivated in order to enhance their safety performance.

This study also found that management played a key role in providing safety information to EMWs, and EM management received more feedback from EM crews than local management. It is necessary for employers to recruit EM staff when they hire EMWs who can act as a bridge among local safety officers, local workers, and EMWs (Chan et al., 2016). Although local management is vital in distributing safety information, they are deficient in promoting the upward communication of EMWs. High-quality relationships between local management and EMWs should be established, so that EMWs feel free to provide their feedback and raise safety related concerns.

Another finding is that the centrality of EMWs within the safety communication network was significantly related to their age, perceived priority of safety, and language ability. EMWs who were young (i.e., under 30 years), trilingual, and perceived a high level of organisational support tended to have higher centrality than their counterparts. This finding also implies that management should pay special attention to the safety communication of older workers and monolingual workers who are positioned on edges of networks. This may ultimately help to increase the overall network density.

9.3 SIGNIFICANCE AND CONTRIBUTIONS

9.3.1 Identifying safety and health problems of EM construction workers in a non-English speaking jurisdiction

The findings of this research contribute to updating the existing body of knowledge on safety and health problems encountered by EMWs, especially in the non-English speaking jurisdiction. Although many studies have been carried out on the safety and health of EMWs, they were mainly conducted in English-speaking countries (e.g., Dainty et al., 2007; Bust et al., 2008). Limited literature can be found in jurisdictions where English is the second or third language. This study identified and evaluated the relative severity of construction safety and health related problems experienced by EMWs in the Hong Kong construction industry. The significance lies in updating and enriching the limited body of knowledge on construction safety and health problems of EMWs and highlighting the peculiar characteristics of these problems in a non-English speaking jurisdiction. The findings of key safety and health problems of EMWs will be of value to various stakeholders in formulating safety and health measures for EMWs.

9.3.2 Identifying safety communication factors of construction workers of EM construction workers

Considering that there has been a lack of investigation of the factors influencing the effectiveness of safety communication of construction workers, this study is probably the first to identify comprehensive safety communication factors of construction workers. A combination of a literature review, interviews, and expert evaluation was used to design a 36 safety communication factors questionnaire. Based on the perceptions and assessment of EM construction workers, 18 SC factors were found to be critical for their effectiveness in regards to safety communication. With the help of EFA, the critical SC factors were categorised into three groups: worker-related, management-related, and organisation-related SC factors. The research findings will provide stakeholders with the valuable insights needed to improve the safety communication of EM construction workers. Previous studies have mainly focussed on the importance of the language ability of EMWs and safety training in their safety communication. This study found that it is insufficient to merely apply a simple strategy to improve the effectiveness of the safety communication of EMWs. A joint strategy of simultaneously controlling multiple safety communication factors could be more effective. The identified critical SC factors for EMWs could help industry practitioners to diagnose the deficiencies in safety communication management with EMWs. The SC questionnaire designed in the current study can be adopted by the government, contractors, subcontractors, and other stakeholders to capture critical SC factors for both employed local and EM construction workers.

9.3.3 Providing the safety communication factors and safety performance model of EM construction workers

To date, very limited comprehensive lists of safety communication factors for EMs exist in literature, and most of these factors are fragmented, having inadequate results of their effects on safety performance. The current study identified critical safety communication factors for EMs and further examined their direct and indirect effects on the safety performance of EMs in the construction industry. With the help of SEM, the relationships among safety communication factors of EMs, safety knowledge, safety motivation, safety compliance and safety participation were estimated. In the direct model, the three groups of critical safety communication factors of EMWs demonstrated significantly predictive roles in the safety performance of EMWs. In the indirect model, the effects of these three groups of critical safety communication factors of EMWs were also indirect on safety performance through safety knowledge and safety motivation as complete mediators. This indirect model provides additional insights, as it supports a different prediction for how to improve safety performance than the direct model. To the author's knowledge, the current study is the first to successfully test the theoretical model of safety communication factors and safety performance of EMWs. This offers empirical evidence regarding the cause-effect relationships between safety communication factors and safety performance of EMWs. A better understanding of the mechanism by which safety communication factors influence the safety compliance and safety participation of EMWs is likely to be beneficial for employers to design suitable safety and prevention programs for EMWs. The interventions focusing on the three groups of critical safety communication factors would contribute to improving safety behaviours and reducing accident rates of EMWs.

9.3.4 Comparing safety communication factors among EMs, management staff and local construction workers

This study contributes to revealing the divergences in the perceptions about safety communication factors between EMWs and management staff, and between EMWs and local workers. The perceptions of management staff and local construction workers about safety communication factors were also examined in this study to compare with the perceptions of EMWs. This study revealed that there was significant disagreement in the rankings of safety communication factors of EMWs between management staff and EMWs, indicating that management staff did not share the same opinions about the relative importance of safety communication factors with EMWs. The identified safety communication factors of EMWs, in which EMWs and management had significantly different perceptions, can guide management staff in raising their awareness and prioritising their efforts towards improving the effectiveness of the safety communication of EMWs. Additionally, the significant disagreement in the ranking of safety communication factors between EMWs and local workers found in this study demonstrates that the methods for improving safety communication of EMWs and local workers differed.

The effects of critical safety communication factors of local workers on their safety performance were also tested. The differences in the structural equation model of EMs and local workers were identified. The results imply that the mechanism by which safety communication factors influence the safety compliance and safety participation of EMs and local construction workers differed largely. It is highly likely that the methods for improving the safety communication of local workers are not suitable and effective for EMWs. This sheds light on further improvements for the safety communication of EMWs and highlights the importance to design safety management, especially for EMWs.

9.3.5 Modelling and evaluating the predominant safety communication networks of EM crews

This study also contributes to filling in the research gaps by modelling and analysing the predominant safety communication networks of EM crews using social network analysis. The extant research on unveiling the communication networks of EM workers is very limited. Most existing studies of EMWs have relied on ethnographic research methods (Tutt et al., 2011; Tutt et al., 2013) and case studies (Hare et al., 2012) to investigate their safety communication. The process of building SNA sociograms will help safety researchers and practitioners to better understand the existing predominant safety communication patterns of EM crews. The individual and network level measures calculated by UCINET can help to evaluate the safety communication networks of EM crews. The overall findings have substantial implications for authentic safety communication patterns of EM crews and advancing research on safety communication networks. Despite the fact that research into safety communication networks was conducted in the context of Hong Kong, the findings have important implications for the safety management of EMWs in many other countries where EMWs are also increasingly employed and suffering high accident rates.

9.3.6 Establishing relationships among safety communication network, individual attributes, and safety performance of EM crews

Previous researchers have highlighted that safety communication patterns are of great importance to safety success; however, the relationship between the structure of safety communication of EM crews and their safety performance has yet to be investigated. This study contributes to capturing the connections between safety communication networks and the safety performance of EM construction crews. The high safety performing EM crews were characterised by higher network densities and higher arc and dyad reciprocity. The SNA measures of safety communication networks can serve as effective leading indicators of the safety performance of EM crews. The data of SNA measures that represent the actual network patterns can be compared with the ideal networks to diagnose the deficiencies that need to be remedied.

In addition, the current study also provides practitioners with important information regarding the predictors of network positions based on the individual attributes of crew members. This finding can help management to construct well-structured networks based on the attributes of crew members, such as age, educational level, and language ability.

9.4 LIMITATIONS OF THE RESEARCH

Despite the achievement of the objectives, there are several limitations in the current study. First, to achieve Objective 1, safety and health problems of EMs were identified and evaluated from the perspective of clients, contractors, governments, and industry institutions in this study. However, the viewpoints of EM frontline construction workers were not included, which might differ greatly from the viewpoints of clients, contractors, governments, and industry institutions. Therefore, future research could be expanded to include the EMWs' viewpoints for improving their safety performance.

Second, as it is difficult to construct a sampling frame, a convenience sampling method instead of random sampling was used in this study to collect data from EMs and local workers in questionnaire survey 1. To remedy the defects of the convenience sampling method, some measures were taken in this study, such as achieving a high level of diversity of respondents and avoiding clustering within specific construction sites. Although the respondents were not randomly selected from the entire population, the collected sample is reasonably expected to be a convincing cross-section sample of the whole population.

The third limitation of this study is that relatively fewer questionnaires were collected in the Australian construction industry compared to those in Hong Kong. Although great effort was made to persuade project managers, assistant project managers, and safety managers in many projects to participate in the questionnaire surveys, only a small number agreed to participate in this research.

The fourth limitation is that the current study was unable to validate the structural equation model with another sample of data. If the structural equation model was tested in a calibration sample and validated in a validation sample, the results would be more reliable and valid. However, due to time constraints, the sample of data collected from EM construction workers was insufficient to split into a calibration and a validation sample.

The fifth limitation lies in that although the sample size used in the analysis of safety communication networks of EM crews (questionnaire survey 2) satisfied the requirement of the study, a larger sample is suggested for obtaining more valid and reliable results. Additionally, the sample could be extended to involve local crews for better understanding the uniqueness in the communication structures of EM crews.

The last limitation of the study is that while the construction safety of EMWs is a complex issue, this study focuses only on safety communication, other aspects, such as job security and legal issues were not considered.

9.5 PRACTICAL RECOMMENDATIONS

To improve the effectiveness of safety communication of EMWs, practitioners should take a joint strategy of simultaneously controlling three groups of safety communication factors, including workers, management, and organization. Merely focusing on several SC factors is not effective to improve the safety communication of EMWs. Industry practitioners could take advantage of the three groups of determined critical SC factors for EMWs to diagnose the defects in safety management and adopt appreciate joint strategy to overcome the potential impediments for safety communication of EMWs. For instance, in terms of management related SC factors, a high quality of supervisor-subordinate relationship and trust within team need to be cultivated. The management need to improve their cultural sensitivity and competence and should not rely on their own frame of reference when communicating with EMWs. The communication style of management and the amount of safety information should be appropriate to EMWs. Although local management is unable to communicate with EMWs in their native languages, they should consider the limited language ability of EMWs and try to avoid too much technical terminology and difficult words. In addition, the management should listen carefully and actively to what EMWs express, such as concerns, opinions on various issues, and needs. As for the organization related SC factors, the most important is that organizations should actively demonstrate and convey their support and concerns to their EMWs, avoid of putting much time pressure on EMWs, and adopt visual or pictorial safety materials onsite. Furthermore, adequate and appropriate safety trainings for EMWs should be provided and safety staff from EM's origin need to be hired.

Practitioners can model the safety communication networks of EM construction crews using SNA approach and evaluate communication patterns by calculating SNA measures, which have been demonstrated as useful predictors of safety performance. The safety management can use this tool to periodically examine and monitor the effectiveness of safety communication networks of EM crews and identify the existed weakness in these networks, which will help to achieve safety success of EMWs. In addition, the study suggested that individual attributes of crew members are leading indicators of their positions in the crews, thus safety management could build well-structured networks according to their personal attributes. For example, management from EMs' origin can be employed as they tend to provide safety information to EMWs more efficiently and EMWs are more willing and feel free to communicate with management from their origin. Bilingual and trilingual EM construction workers need to be recruited, as they play an important role in proving safety information to other crew members. Older EM construction workers who are found to be positioned on edges of networks need to be encouraged and motivated to communicate openly and frequently. The employers should value the safety of EMWs by which EMWs will be more willing to report the risky situation and communicate with their management and co-workers more frequently.

9.6 FUTURE RESEARCH DIRECTIONS

The first suggestion for future research is that, as EMWs were not included in initial interviews due to time limitations, interviews with EM construction workers could be conducted to determine the safety and health problems from the perspective of EMWs and comparison could then be made with this study to examine the differences in categories of safety and health problems identified by management and EMWs.

In addition, further research could identify the critical safety communication factors of EMs in other countries where a great number of EM construction workers are recruited, such as the U.K., the U.S., Malaysia, and the Middle East. Comparisons could be made with the current study in Australia and Hong Kong. The research model developed in this study could be replicated to test the robustness of the models in other regions.

Further research also needs to be extended to include the communication networks of local crews, as well as mixed ethnic crews, for better understanding of the distinctive features of safety communication networks of EMWs. As the safety communication network may change over time, a longitudinal study is suggested to examine the safety communication network structures of EM crews.

9.7 CHAPTER SUMMARY

In conclusion, this chapter summarised the major findings, highlighted the significance and contributions, acknowledged the limitations, and suggested directions for further study.

Appendices

APPENDIX A: Accidents of EMs in the construction industry of Hong Kong

Date of accident	Time	Ethnicity	Trade	Causes of Accident	Types of projects
25/05/1998	Around 01:40 p.m.	Philippines	Painter	Fall of person from height	Repair & maintenance
12/02/1999	Around 03:30 p.m.	Thailand	Labour	Trapped by collapsing or overturning object	New building
01/07/1999	Around 08:49 a.m.	Nepali	Labour	Struck by falling object	Others
26/07/1999	Around 09:00 a.m.	Nepali	Labour	Slip, trip or fall on same level	Road and drainage work
08/10/1999	Around 11:00 a.m.	EM	Engineer	Fall of person from height	Repair & maintenance
27/11/1999	Around 10:00 a.m.	Nepali	Welder	Slip, trip or fall on same level	Subway and high-speed rail project
13/12/1999	Around 02:55 p.m.	EM	Engineer, Labour	Exposure to explosion	Road and drainage work
07/01/2000	08:43 p.m.	EM	Welder	Exposure to fire	Subway and high-speed rail project
15/01/2000	Around 02:00 p.m.	Nepali	Labour	Trapped in or between objects	New building
27/02/2000	Around 01:00 p.m.	Nepali	Labour	Struck by falling object	Subway and high-speed rail project
05/07/2000	Around 11:50 a.m.	Nepali	Labour	Fall of person from height	Repair & maintenance
21/12/2000	Around 10:00 a.m.	India	Labour	Struck by falling object	Subway and high-speed rail project
19/06/2001	Around 04:30 p.m.	Nepali	Security	Others	Subway and high-speed rail project
01/08/2001	Around 08:00 a.m.	Nepali	Bar bender	Struck by falling objects	New building
29/10/2001	Around 11:00 a.m.	Vietnam, Pakistan	Demolition	Trapped by collapsing or overturning object	Demolition
03/12/2001	Around 12:00 a.m.	Nepali	Labour	Fall of person from height	New building
21/06/2002	Around 05:00 p.m.	Nepali	Labour	Fall of person from height	New building

26/08/2002	Around 09:08 p.m.	Nepali	Labour	Struck by falling objects	New building
21/02/2003	Around 10:45 a.m.	Nepali	Demolition	Fall of person from height	Demolition
23/02/2003	Around 09:00 p.m.	Nepali	Labour	Fall of person from height	Subway and high-speed rail project
26/06/2003	Around 06:00 p.m.	Nepali	Repair & Maintenance	Fall of person from height	Repair & maintenance
19/08/2003	Around 10:50 a.m.	Nepali	Labour	Struck by falling object	New building
20/07/2004	Around 09:00 p.m.	Nepali	Electrician	Struck by falling object	Subway and high-speed rail project
15/10/2004	11:26 p.m.	EM	Labour	Slip, trip or fall on same level	New building
03/06/2005	Around 02:00 p.m.	Nepali	Labour	Fall of person from height	Subway and high-speed rail project
18/08/2005	Around 12:00 a.m.	Nepali	Labour	Others	Road and drainage work
02/02/2006	Around 02:00 p.m.	EM	Labour	Exposure to explosion	Road and drainage work
03/02/2006	Around 10:00 a.m.	Nepali	Labour	Exposure to or contact with harmful substance	Road and drainage work
07/07/2006	Around 03:10 p.m.	Pakistani	Labour	Trapped by collapsing or overturning object	Road and drainage work
17/07/2006	Around 06:01 p.m.	Nepali	Labour	Fall of person from height	New building
03/10/2006	Around 09:00 a.m.	Pakistani	Caretaker	Injured in workplace violence	New building
21/10/2006	Around 01:30 p.m.	Nepali	Labour	Fall of person from height	New building
18/08/2007	Around 04:50 p.m.	Nepali	Labour	Struck by falling object	Road and drainage work
27/12/2007	Around 02:00 p.m.	Nepali	Labour	Struck by falling object	New building
21/04/2008	Around 03:00 p.m.	Germany Pakistan	Technician	Contact with moving machinery or object being machine	Subway and high-speed rail project
11/11/2008	Around 10:53 a.m.	Nepali	Labour	Exposure to explosion	Road and drainage work
12/03/2009	Around 02:00 p.m.	South Asian	Repair & Maintenance	Exposure to or contact with harmful substance	Repair & maintenance
27/04/2009	Around 12:00 a.m.	Pakistan	Repair & Maintenance	Fall of person from height	Repair & maintenance
27/05/2009	Around 03:49 a.m.	Pakistani	Repair & Maintenance	Struck by moving object	Road and drainage work

02/07/2009	Around 1:00 p.m.	Pakistani	Painter	Fall of person from height	Others
24/10/2009	11:06 a.m.	South Asian	Demolition worker	Fall of person from height	Others
08/01/2010	Around 2:00 p.m.	South Asian	Plumber	Fall of person from height	Others
24/03/2010	Around 4:00 p.m.	South Asian	Labour	Fall of person from height	New building
10/06/2010	around 10:00 a.m.	South Asian	Labour	Struck by moving object	Others
18/08/2010	around 03:00 p.m.	Indian	Painter	Fall of person from height	Repair & maintenance
02/02/2011	Around 12:00 noon	South Asian	Labour	Trapped by collapsing or overturning object	Others
07/04/2011	Around 10:40 a.m.	Nepali	Labour	Struck by falling object	Road and drainage work
09/08/2011	Around 5:00 p.m.	Nepali	Labour	Struck by moving object	Subway and high-speed rail project
07/12/2011	Around 5:00 p.m.	Vietnamese	Bar bender	Fall of person from height	New building
08/01/2012	Around 12:00 noon	Nepali	Labour	Fall of person from height	New building
14/03/2012	Around 1:00 p.m.	South Asian	Labour	Slip, trip or fall on same level	Others
15/03/2012	Around 10:30 p.m.	Nepali	Labour	Injured by hand tool	Road and drainage work
10/07/2012	Around 8:00 a.m.	Philippine	Labour	Fall of person from height	Others
25/07/2012	Around 10:00a.m.	South Asian	Painter	Fall of person from height	New building
29/10/2012	Around 4:00 p.m.	Nigerian	Labour	Exposure to explosion	New building
14/12/2012	Around 08:13 a.m.	Nepali	Labour	Fall of person from height	New building
20/01/2013	Around 10:00a.m.	Nepali	Labour	Struck by moving object	Subway and high-speed rail project
18/03/2013	Around 10:00a.m.	Nepali	Labour	Struck by falling object	Subway and high-speed rail project
25/05/2013	Around 10:00a.m.	South Asian	Labour	Struck by moving object	New building
04/06/2013	Around 10:00a.m.	Pakistani	Labour	Exposure to explosion	Repair & maintenance
11/07/2013*	Around 3:00p.m.	Pakistani	Labour	Trapped by collapsing or overturning object	Road and drainage work
02/08/2013	Around 04:00 p.m.	German	Engineer	Trapped by collapsing or overturning object	Subway and high-speed rail project
28/08/2013	Around 01:00 p.m.	South Asian	Labour	Struck by falling object	New building

17/09/2013	02:28 a.m.	Nepali	Plumber	Struck by moving vehicle	Subway and high-speed rail project
03/10/2013	Around 06:00 a.m.	Nepali	Labour	Contact with electricity or electric discharge; slip, trip or fall on same level	Subway and high-speed rail project
22/10/2013	Around 10:00a.m.	South Asian	Labour	Exposure to explosion	Road and drainage work
11/11/2013	Around 03:00 p.m.	Philippine	electrician	Contact with electricity or electric discharge	Subway and high-speed rail project
25/03/2014*	Around 11:00a.m.	Vietnamese	Labour	Fall of person from height	Repair & maintenance
16/06/2014	Around 02:25 a.m.	Nepali	Labour	Others	New building

Note: * Fatal accident. Source: Local newspaper archives from 1998 to June 2014

APPENDIX B: Literature reviewed for safety communication factors

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APPENDIX C: Interview questions

1. In what construction trades do most EMWs join? Any effects to their safety performance?
2. What are the major safety and health problems experienced by EMWs in construction sites?
3. What are the current practices in management of safety of EMWs in construction sites? (any different treatment for EMWs)
4. What are the difficulties for EMWs to comply with safety rules and regulations?
5. Can you compare safety behaviour/attitude of EMWs with that of local workers?
6. Can you give any recommendations for improving safety performance of EMWs?
7. Do you have any information about accident cases of EMWs?
8. What is the existing communication network structure?
9. What could be an effective communication network structure?
10. Whether, good safety performance staff has an effective communication structure?
11. What are the main communication tools (e.g. mobile phone, body language) and means (language) used by the EMWs in construction sites?
12. How frequently safety manager interacts directly with EMWs? Whether interpreters or translators are used for effective safety communication with EMWs?
13. What modes (formal and informal) of safety communication are used for EMWs by the safety manager in construction site? Who will the EMWs seek help in case of safety problems?
14. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?
15. What are the major safety communication problems of EMWs?
16. What are the key success factors of effective safety communication of EMWs

in construction sites?

17. What measures should be taken to improve safety communication of EMWs in construction site?

APPENDIX D: Questionnaire for Delphi survey

Questionnaire of Delphi survey

Section A: About the Respondent *(Only overall statistical data will be compiled, i.e., individuals not identifiable)*

1. Your current position: ______________________________
2. Name of your organization: _______________________________
3. Nature of your organization:
   ☐ HKSAR Government ☐ Quasi-government ☐ Private Developer ☐ Contractor
   ☐ Sub-contractor ☐ Property/Facilities Management Company
   ☐ Construction Industry Institute ☐ Other pls. specify: _____________
4. Do you have any experience of working with ethnic minority (EM) construction workers?
   ☐ Yes ☐ No
   If YES then in which group of ethnic minority workers and approximate number?
   ☐ Nepalese (Number_____________) ☐ Pakistani (Number_____________)
   ☐ Philippines (Number _____________) ☐ Indian (Number _____________)
   ☐ Other pls. specify: _____________
5. How many years of working experience do you have in the construction industry?
   ☐ <1 year ☐ 1–5 years ☐ 6–10 years ☐ 11–15 years ☐ 16–20 years ☐ >20 years

Section B: Safety management problems identified for improving the safety performance of EM workers *(Only overall statistical data will be compiled, i.e., individuals not identifiable)*

Please rate the following statements based on a scale from 1 to 5, where “1” represents “Strongly disagree”, “3” represents “Neither agree nor disagree “and “5” represents “Strongly agree”.

Please rate the relative severity of the following problems experienced by EM workers:	*1*	*2*	*3*	*4*	*5*
1. Low safety and health awareness and knowledge of EM workers	☐	☐	☐	☐	☐
2. Safety communication problems	☐	☐	☐	☐	☐
3. Neglect of cultural and religious differences	☐	☐	☐	☐	☐
4. Low skill level of EM workers	☐	☐	☐	☐	☐
5. Lack of safety culture and management commitment for EM workers	☐	☐	☐	☐	☐
6. Insufficient safety training for EM workers in their native languages	☐	☐	☐	☐	☐
7. Insufficient safety materials in EM native languages	☐	☐	☐	☐	☐
8. Insufficient safety staff of EM origin	☐	☐	☐	☐	☐
9. Lack of opportunities for EM workers' recruitment and career development	☐	☐	☐	☐	☐
10. Absence of separate government budget and subsidy for safety management of EM workers	☐	☐	☐	☐	☐
11. Lack of government support to enhance EM workers’ safety performance	☐	☐	☐	☐	☐
12. EM workers are assigned more laborious and unsafe work	☐	☐	☐	☐	☐
13. Personal characteristic of EM workers influences their safety performance	☐	☐	☐	☐	☐
14. Racial discrimination against EM workers	☐	☐	☐	☐	☐

APPENDIX E: Questionnaire for survey 1

Improving safety communication of construction workers
Questionnaire
(For ethnic minority and local construction workers)

Section A – Respondent Background

Instructions: *Please answer this questionnaire regarding your current project site.*

1. Your country of origin is:_____________________________

2. The country of origin of your supervisor is:_____________________________

3. The country of origin of most co-workers is:_____________________________

4. How long have you been in this country:_____________________________

6. Your work trade/department: ______________________________

7. Your working level:

☐ Frontline worker ☐ Supervisor ☐ Manager ☐ Others __________________

8. Your age:

☐ 20 or below ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ 61 or above

9. Years of working experience in the construction industry:

☐ < 1 year ☐ 1-5 years ☐ 6-10 years ☐ 11-15 years ☐ 16 years or above

10. Your current professional affiliation:

☐ Main contractor ☐ Subcontractor ☐ Others ______________________

11. Your educational level:

☐Junior or below ☐Middle school ☐High school ☐Certificate/diploma ☐Degree or higher

12. How long have you been on this job site?

☐ < 1 month ☐ 1-5 months ☐ 6-12 months ☐ > 12 months

13. Which language are you fluent in: ___________________________

14. Language of written safety instructions (poster, booklet) is ___________________________

15. The language of safety trainings is ______________________

16. The language of safety meetings is ______________________

17. Number of accidents and occupational injuries in the **last 12 months**

(1 = Never; 2 = 1 time; 3 = 2-3 times; 4 = 4-5 times; 5 = Over 5 times)						
a)	How many times have you exposed to a near miss incident of any kind at work?	1	2	3	4	5
b)	How many times have you suffered from an accident/ injury of any kind at work, but did NOT require absence from work?	1	2	3	4	5
c)	How many times have you suffered from an accident/ injury, which require absence from work NOT exceeding 3 consecutive days?	1	2	3	4	5
d)	How many times have you suffered from an accident/ injuries, which require absence from work exceeding 3 consecutive days?	1	2	3	4	5

Section B: Factors that may affect the effectiveness of your safety communication positively.

1 = Not Important; 2 = Slightly Important; 3 = Moderately Important; 4 = Important; 5 = Very Important

Please rate the importance of the following factors in improving your safety communication	*Not Important ⟵⟶ Very Important*				
1. Adequacy of workers' understanding of culture in host country	1	2	3	4	5
2. Sufficient educational level of workers	1	2	3	4	5
3. Cultural and ethnical background of workers	1	2	3	4	5
4. Having work experience in construction	1	2	3	4	5
5. Adequacy of language ability of workers	1	2	3	4	5
6. Personality characteristics of workers	1	2	3	4	5
7. Age of workers	1	2	3	4	5
8. No drinking habits of workers	1	2	3	4	5
9. Good emotional state of workers	1	2	3	4	5
10. Providing feedback from workers to management	1	2	3	4	5
11. Appropriateness of language used by management	1	2	3	4	5
12. Appropriateness of communication style of management	1	2	3	4	5
13. Avoiding using too much technical terminology and difficult words by management	1	2	3	4	5
14. Degree of power or status differences between construction workers and their management staff	1	2	3	4	5
15. Appropriateness of the amount of safety information presented at one time by management	1	2	3	4	5
16. Adequacy of explanations of procedures, rules and policy by management	1	2	3	4	5
17. Active and careful listening to workers	1	2	3	4	5
18. Good attitude and mood of management	1	2	3	4	5
19. Adequacy of time when communicating with workers	1	2	3	4	5
20. Appropriateness of time when safety information is provided	1	2	3	4	5
21. Building trust within the team	1	2	3	4	5
22. Relevance and accuracy of safety information provided by management	1	2	3	4	5
23. Cultural sensitivity and competence of management	1	2	3	4	5
24. High quality of supervisor-subordinate relationship	1	2	3	4	5
25. Appropriateness of communication channel adopted to convey safety information	1	2	3	4	5
26. Employment of safety staff from workers' origin country	1	2	3	4	5
27. Application of pictorial or visual safety materials	1	2	3	4	5
28. Accuracy of translations of safety messages	1	2	3	4	5
29. Adequacy and appropriateness of formal presentation from upper management	1	2	3	4	5
30. Adequacy and appropriateness of written communication	1	2	3	4	5
31. Adequacy and appropriateness of safety trainings	1	2	3	4	5
32. Adequacy and appropriateness of toolbox talks	1	2	3	4	5
33. Organizational support and concern	1	2	3	4	5
34. No much time pressure for completion of the project	1	2	3	4	5
35. Appropriate composition of construction team members	1	2	3	4	5
36. Appropriateness of physical environment	1	2	3	4	5

Section C: Measures of Safety Performance

1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly Agree

Please selecting √ the most appropriate boxes to show your level of agreement	Disagree ⟵				→ Agree
1. I know how to perform my job in a safe manner.	1	2	3	4	5
2. I know how to use safety equipment and standard work procedures.	1	2	3	4	5
3. I know how to reduce the risk of accidents and incidents in the workplace.	1	2	3	4	5
4. I believe that safety at workplace is a very important issue.	1	2	3	4	5
5. I feel that it is important to encourage others to use safe practices.	1	2	3	4	5
6. I feel that it is important to promote safety programmes.	1	2	3	4	5
7. I use all necessary safety equipment to do my job.	1	2	3	4	5
8. I follow correct safety rules and procedures while carrying out my job.	1	2	3	4	5
9. I ensure the highest levels of safety when I carry out my job.	1	2	3	4	5
10. I put extra effort to improve the safety of the workplace.	1	2	3	4	5
11. I voluntarily carryout tasks or activities that help to improve workplace safety.	1	2	3	4	5
12. I encourage my co-workers to work safely.	1	2	3	4	5

Improving safety communication of construction workers Questionnaire
(For management)

Section A–Respondent Background

Instructions: *Please answer this questionnaire regarding your current project site.*

1. Your position:

☐ Supervisor ☐ Manager ☐ Others ______________________________________

2. Your country of origin: ______________________________________

3. Years of working experience in the construction industry:

☐ < 1 year ☐ 1-5 years ☐ 6-10 years ☐ 11-15 years ☐ 16 years or above

4. Your current professional affiliation:

☐ Main contractor ☐ Subcontractor ☐ Others ________________________________

5. Your educational level:

☐Junior or below ☐Middle school ☐High school ☐Certificate/diploma ☐Degree or higher

6. Which **language** are you fluent in?

☐ English ☐ Cantonese ☐Mandarin ☐Nepalese ☐Pakistani
☐Others________________________________

7. How many years of **work experience** with **EM construction workers**?

☐0 ☐ < 1 year ☐ 1-5 years ☐ 6-10 years ☐ 11-15 years ☐ 16 years or above

If you have then in **which group** of ethnic minority workers and approximate **number**?

☐ Nepalese (Number______________) ☐ Pakistani (Number______________)
☐ Philippines (Number ______________) ☐ Indian (Number ______________)
☐ Other pls. specify: ______________

Reply Slip (Optional)

Those who wish to receive a summary of the research findings, please enter the details below:

Name: ________________________ Position:_______________________________

Organization:____

Telephone Number:____________________ Email Address:__________________

Section B–Factors affecting the effectiveness of safety communication of Ethnic Minority (EM) or migrant construction workers onsite

1 = Not Important; 2 = Slightly Important; 3 = Moderately Important; 4 = Important; 5 = Very Important

Please rate the importance of each factor in improving safety communication of EM construction workers	*Not Important ⟵⟶ Very Important*				
1. Adequacy of workers' understanding of culture in host country	1	2	3	4	5
2. Sufficient educational level of workers	1	2	3	4	5
3. Cultural and ethnical background of workers	1	2	3	4	5
4. Having work experience in construction	1	2	3	4	5
5. Adequacy of language ability of workers	1	2	3	4	5
6. Personality characteristics of workers	1	2	3	4	5
7. Age of workers	1	2	3	4	5
8. No drinking habits of workers	1	2	3	4	5
9. Good emotional state of workers					
10. Providing feedback from workers to management	1	2	3	4	5
11. Appropriateness of language used by management	1	2	3	4	5
12. Appropriateness of communication style of management	1	2	3	4	5
13. Avoiding using too much technical terminology and difficult words by management	1	2	3	4	5
14. Degree of power or status differences between construction workers and their management staff	1	2	3	4	5
15. Appropriateness of the amount of safety information presented at one time by management	1	2	3	4	5
16. Adequacy of explanations of procedures, rules and policy by management	1	2	3	4	5
17. Active and careful listening to workers	1	2	3	4	5
18. Good attitude and mood of management	1	2	3	4	5
19. Adequacy of time when communicating with workers	1	2	3	4	5
20. Appropriateness of time when safety information is provided	1	2	3	4	5
21. Building trust within the team	1	2	3	4	5
22. Relevance and accuracy of safety information provided by management	1	2	3	4	5
23. Cultural sensitivity and competence of management	1	2	3	4	5
24. High quality of supervisor-subordinate relationship	1	2	3	4	5
25. Appropriateness of communication channel adopted to convey safety information	1	2	3	4	5
26. Employment of safety staff from workers' origin country	1	2	3	4	5
27. Application of pictorial or visual safety materials	1	2	3	4	5
28. Accuracy of translations of safety messages	1	2	3	4	5
29. Adequacy and appropriateness of formal presentation from upper management	1	2	3	4	5
30. Adequacy and appropriateness of written communication	1	2	3	4	5
31. Adequacy and appropriateness of safety trainings	1	2	3	4	5
32. Adequacy and appropriateness of toolbox talks	1	2	3	4	5
33. Organizational support and concern	1	2	3	4	5
34. No much time pressure for completion of the project	1	2	3	4	5
35. Appropriate composition of construction team members	1	2	3	4	5
36. Appropriateness of physical environment	1	2	3	4	5

APPENDIX F: Questionnaire for survey 2

Instructions: *Please answer this questionnaire with reference to your current project site.*

Section A: Personal and Safety Communication Information:

<u>Country of Origin</u>**:** ☐ Australia ☐ Hong Kong ☐ Mainland China ☐ Nepal ☐ Pakistan ☐ Other ________________

Please answer this section by selecting √ the most appropriate boxes.

1. Your working level:	☐ Frontline worker ☐ Clerical staff (e.g. security staff) ☐ Supervisor ☐ Manager
2. Your current position:________________	Company: ________________
3. Your work trade/department:	☐ Labourer ☐ Plumber ☐ Scaffolder ☐ Plasterer ☐ Carpenter (formworker) ☐ Concretor ☐ Metal worker ☐ Joiner ☐ Bar bender & fixer ☐ Plant & equipment operator ☐ Building services/ E&M worker ☐ Demolition worker ☐ Painter & decorator ☐ Safety ☐ Engineering ☐ Project Management ☐ Surveying Department ☐ Others ________________
4. Your age:	☐ 20 or below ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ 61 or above
5. Your gender:	☐ Male ☐ Female
6. Your marital status:	☐ Single ☐ Married
7. Number of family members supported by you (excluding yourself):	☐ None ☐ 1-2 ☐ 3-4 ☐ 5-6 ☐ 7 or more
8. Your education level:	☐ Below primary ☐ Primary ☐ Secondary ☐ Certificate/ Diploma ☐ Degree or higher
9. Your direct employer:	☐ Client ☐ Main contractor ☐ Subcontractor ☐ Others ___________
10. Your current job status and pay status (You may tick more than 1 box, if applicable):	☐ Temporary staff ☐ Regular staff ; ☐ Daily payee ☐ Salaried worker
11. How long have you been on this job site?	☐ < 1 month ☐ 1-5 months ☐ 6-12 months ☐ > 12 months
12. Years of working experience in the construction industry:	☐ < 1 year ☐ 1-5 years ☐ 6-10 years ☐ 11-15 years ☐ > 16 years

13. Did you receive induction safety training at this project? ☐ Yes ☐ No ☐ Don't know

14. When did you receive induction safety training at this project?
☐ at the start of my work ☐ < 3 months ago ☐ 6 months ago ☐ 1 year ago ☐ > 1 year ago

15. What is the language of safety induction trainings? You may select √ more than 1 box, (if applicable)
☐ Chinese only ☐ English only ☐ Both Chinese and English ☐ Chinese, English and Nepali ☐ Urdu ☐ Hindi ☐ Other ___________

Section B: Safety Communication Flow

Statements		1	2	3	4	5	6	7
1. Name of individuals from whom you **RECEIVE** safety information:	First Name							
	Last Name							
	Position							
2. Which language is used for safety communication with this person (check √ all boxes that apply):	Chinese							
	English							
	Nepali							
	Urdu							
	Hindi							
	Body Language							
	Others (please specify)							
3. Frequency of safety communication (check √ boxes):	Twice a Day							
	More than Twice a Day							
	Weekly							
	Bi-Weekly/Fortnightly							
	Once a Month							
	Others (please specify)							
4. Most common communication tool(s) used in construction site	1. Body language (gestures)							
	2. Walki Talki (Wireless)							
	3. Face to Face							
	4. Mobile (Whatsapp, WeChat etc.)							
	5. Safety Sign (Pictogram)							
	6. Internet (email)							
	7. Written memo/letter							
	8. Interpreter or Translator							

Statements		1	2	3	4	5	6	7
1. Name of individuals to whom you **Provide** safety information:	First Name							
	Last Name							
	Position							
2. Which language is used for safety communication with this person (check √ all boxes that apply):	Chinese							
	English							
	Nepali							
	Urdu							
	Hindi							
	Body Language							
	Others (please specify)							
3. Frequency of safety communication (check √ boxes):	Twice a Day							
	More than Twice a Day							
	Weekly							
	Bi-Weekly/Fortnightly							
	Once a Month							
	Others (please specify)							
4. Most common communication tool(s) used in construction site	1. Body language (gestures)							
	2. Walki Talki (Wireless)							
	3. Face to Face							
	4. Mobile (Whatsapp, WeChat etc.)							
	5. Safety Sign (Pictogram)							
	6. Internet (email)							
	7. Written memo/letter							
	8. Interpreter or Translator							

Section C: Safety climate

Please circle the appropriate number to show your level of agreement with each of the following statements.	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
1. Productivity is usually seen as more important than safety and health by the company	1	2	3	4	5
2. People can always get the equipment which is needed to work according to the safety and health procedures	1	2	3	4	5
3. I fully understand the safety and health risks associated with the work for which I am responsible	1	2	3	4	5
4. Some safety and health rules or procedures do not reflect how the job is now done	1	2	3	4	5
5. I feel involved in the development and review of safety and health procedures or conduct risk assessment	1	2	3	4	5
6. People here always work safely even when they are not being supervised	1	2	3	4	5
7. Suggestions to improve safety and health are seldom acted upon	1	2	3	4	5
8. The company really cares about the safety and health of the people who work here	1	2	3	4	5
9. Most of the job-specific safety trainings I received are effective	1	2	3	4	5
10. People are just unlucky when they suffer from an accident	1	2	3	4	5
11. Some safety and health rules or procedures are difficult to follow	1	2	3	4	5
12. People here always wear their personal protective equipment (e.g. eye protectors, masks, ear protectors, etc.) when they are supposed to	1	2	3	4	5
13. All the people who work in my team are fully committed to safety and health	1	2	3	4	5
14. Little is done to prevent accidents until someone gets injured	1	2	3	4	5
15. The company encourages suggestions on how to improve safety and health	1	2	3	4	5
16. There is good preparedness for emergency here	1	2	3	4	5
17. Sometimes it is necessary to take risks to get the job done	1	2	3	4	5
18. I know that if I follow the safety rules or procedures, I will not get hurt	1	2	3	4	5
19. I am clear about what my responsibilities are for safety and health	1	2	3	4	5
20. Some of the workforces pay little attention to safety and health	1	2	3	4	5
21. There are good communications here between management and workers about safety and health issues	1	2	3	4	5

22. There are always enough people available to get the job done according to the safety and health procedures	1	2	3	4	5
23. Safety and health procedures are much too stringent in relation to the risks	1	2	3	4	5
24. Sufficient resources are available for safety and health here	1	2	3	4	5
25. It is important for me to work safely if I want to keep the respect of others in my team	1	2	3	4	5
26. Work safety and health is not my concern	1	2	3	4	5
27. Time pressures for completing jobs are reasonable	1	2	3	4	5
28. Safety inspection here is helpful to improve the safety and health of workers	1	2	3	4	5
29. Some jobs here are difficult to do safely	1	2	3	4	5
30. Accidents which happened here are always reported	1	2	3	4	5
31. My workmates would react strongly against people who break safety and health procedures	1	2	3	4	5
32. Not all the safety and health rules or procedures are strictly followed here	1	2	3	4	5
33. My immediate boss often talks to me about safety and health matters on site	1	2	3	4	5
34. Staff are praised for working safely	1	2	3	4	5
35. Supervisors sometimes turn a blind eye to people who are not observing the safety and health procedures	1	2	3	4	5
36. The risk controls do not get in the way of doing my job	1	2	3	4	5
37. Accident investigations are mainly used to identify who should be blamed	1	2	3	4	5
38. I think management here does enough to follow up recommendations from safety inspection and accident investigation reports	1	2	3	4	5

Occupational Safety and health Council (OSHC)'s permission to allow the researchers to adopt the "Safety Climate Index (SCI) in the Construction Industry" in Section C of this study is gratefully acknowledged.

End of the questionnaire. Thank you for your contribution!

APPENDIX G: Syntax to evaluate the effects of two mediators

```
#Region "Header"
Option Explicit On
Option Strict On
Imports System
Imports Microsoft.VisualBasic
Imports AmosEngineLib
Imports AmosEngineLib.AmosEngine
Imports AmosEngineLib.AmosEngine.TMatrixID
Imports MiscAmosTypes
Imports MiscAmosTypes.cDatabaseFormat
#End Region
Public Class CUserValue : Implements IUserValue
   Function Value( groupNumber As Integer, bootstrapSampleNumber As
Integer, v As CValue) As Object Implements IUserValue.Value
   Dim x(2) As Double
 x(0) = v.ParameterValue("a1")*v.ParameterValue("b1")
 x(1) = v.ParameterValue("a2")*v.ParameterValue("b2")
x(2) = x(1) - x(0)
Return x
   End Function
#Region "Advanced"
   Function Label( groupNumber As Integer) As Object Implements
IUserValue.Label
      ' You can replace the following line.
   Dim labels(2) As String
   labels(0) = "WFtoKNOWLtoPART"
   labels(1) = "WFtoMOTIVtoPART"
   labels(2) = "IE difference"
      Return labels
   End Function
   Public Sub Initialize() Implements IUserValue.Initialize
   End Sub
   Sub CleanUp() Implements IUserValue.CleanUp
   End Sub
#End Region
End Class
```

APPENDIX H: Transcripts of interviews

In order to protect the privacy and confidentiality of the interviewees, the information relating identity of individuals and companies were replaced by XXX in the following transcripts.

Interviewee A

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Most of the jobs done by the ethnic minorities are labouring and helping, manual labour. Ethnic minorities are also involved in the operation and maintenance of tunnel boring machines (TBM). We have difficulties in getting local people to work as carpenter, welders, and steel fixers. Most of the local workers for these jobs are older, 50- 65. The majority of the ethnic minority workers under XXX come from Nepal. Some ethnic minority workers come from Pakistan but not many. As a company XXX include all expats in training. All the training courses are provided in three languages, Chinese, English, and Nepalese. In general, people who are giving instructions use the same language as the workers they supervise. Foremen and supervisor level are also from Nepal. Nepalese workers are instructed by their own language. Nepalese accounts for around 40% of the workforce in XXX, some 5-10% are French and a small % are Pakistani. Nepalese workers are reliable, tough, strong, and work hard.

In relation to the question of any effect on their safety performance, it is my opinion that there is no major affect it at all. As a general rule they work in the more dangerous, dirty and tough type of works that locals do not want to do and the Safety performance depends on other factors such us who are in charge of them and what training do they have/need, standard of equipment and personal protection.

We found our expatriate workers easier to control than local subcontractors as they are directly employed and under our direct control. When a subcontractor comes in and we want workers of the subcontractor to work to our safety standard, problems occur. Subcontractors have no safety training and poor levels of supervision often lacking any formal safety training other than the mandatory green card.

It is difficult to tell old construction workers to follow safety rules when, such as when a young graduate engineer tells a 55-year-old welder/ carpenter/ electrician not to do something, he will not listen because he has been doing the same thing for so many years and there is a cultural reluctance from a younger man to tell an older one what to do.

We have more problems dealing with local subcontractors /labour rather than ethnic minority workers, made more difficult the last few years due to the high demand for workers in Hong Kong and Macau, with case where tradesmen have point blank refused to work as we require and leave the site to work elsewhere. There are also difficulties in training locals on safety issues as they do not get paid by their employers for taking time off site to attend the training, this has an obvious knock on effect where they do not benefit from training and do not always understand new methods/equipment etc.

We simply do not have enough experienced people to do many of the jobs we need. My company would for sure bring in more expatriate staff if allowed to do so by Immigration Laws. We have to prove that we cannot find enough local people and then apply to immigration for overseas workers. We make application for all kinds of workers we need. It is difficult to attract Hong Kong people to join construction industry because construction jobs are notoriously hard work and the industry fluctuates creating a sector which has boom and bust every ten years or so, making it an unstable job market as well.

What are the major safety and health problems faced by ethnic minority workers in construction sites?

They don't have special safety and health problems. They tend to take up harder manual labour type of jobs on the sites which the locals do not want to do. Construction work is hazardous by its very nature and risks are forever present, being able to provide training and good supervision helps us to manage those risks the workers are exposed to. We have a high proportion of ethnic minority, we make sure they get the important information and training they need. We try hard as a company to ensure our staff are trained and understand their duties as well as provide good standards of protective equipment for use as necessary

2. What are the current practices in management of safety of ethnic minority workers in construction sites?

Everyone has induction training on every project and must also have a valid Green card (safety Training sanctioned by the labour Dept.). In addition to the legal required Green car, we issue our own internal 'Orange Card' following a full day safety training given to all our staff covering the basic safety.

There are also lessons learnt, tool box talks, new equipment training and many other safety awareness programmes. Safety training is not just one off but continuous. Most of the workers have been with us for quite some time, e.g. for several years. We managed to maintain a group of trained workers. We have Nepal foreman or supervisor to look after the ethnic minority workers. All Nepal foremen can speak English. Older workers rather than younger ones give us the most concern and account for many safety issues. We have Nepalese safety supervisor and safety officer.

We get a quota from the government to employ ethnic minorities. Safety supervisor and safety officer, we train them ourselves. (And register them with labour Department as necessary upon completion of their training) We do have issues in training our non-Chinese speakers in some training courses because the courses in the main are in Chinese. We provide awareness training to these workers in Nepalese and are currently seeking to gain approval from the CIC and Labour Department to acknowledge our training. We will do the green card training in Nepalese to make sure they understand. We get a quota of imported workers from the government against a particular project. If we have another project, we can apply to the government that we want to keep them for another project. We can classify them as special workers/ technicians because they are experienced, especially for TBM operation. There is no TBM training available in Hong Kong. Only we have. Even the Fire Services Department utilize our decompression chamber for training on one of our tunnelling projects. Most of the workers we have are multi-tasking. They have to learn a variety of work tasks. There is a CI scheme to try and encourage and train more locals into the construction industry (CCTS Scheme) but we are finding that the locals are just not interested and there are very few applications.

3. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

I don't think we have difficulties. I can imagine in other companies where a Chinese foreman supervises Nepalese workers this can lead to language problems and cultural issues, the difficulties being that if the workers do not understand what they are supposed to do, or what the hazards are associated with the task they are given then incidents will happen. We have supervisors who speak the same language as the workers and as a company XXX looks after our expatriate workers very well. There are many parties etc. organized and they and their families are included in all company functions. Directors come along to meet the workers. Some of our ethnic workers could earn more salary/bonus than the local workers because some of the jobs are very specialized. We train them, pay them well as we want to keep them. In terms of money, I don't hear they complain. If supervision team and workers cannot communicate, not only safety problems arise but many other issues do as well such as the quality of our work, absenteeism etc.

4. Can you compare safety culture/climate of ethnic minority construction workers with that of local workers?

Ethnic minority workers are more likely to follow the rules. Most of them came from abroad. They don't want to be fired and sent home. The local guys are different. They can get work next door tomorrow if they wish. Ethnic minority workers find it much more difficult to change jobs. (Some may not even be allowed, as they have visa issued specifically for a project.) For those ethnic minority workers, we directly employ, they are more willing to follow the rules. We pay allowance for them for their accommodation. We also employ quite a few Nepalese women, for the less labour-intensive jobs such as traffic guides/ control access routes in the tunnel.

5. Can you give any recommendations for improving safety performance for ethnic minority construction workers?

The local government must deliver the course in the language that they are from. It's no point delivering the course in Chinese. Even there are English course, the Nepalese can't really understand. We found that those who have been trained in English do not really understand. Training should be in their mother language.

Qualification is another issue. We can only find qualified Chinese bobcat machine operator. Ethnic minority workers cannot get in those courses that can earn more money, such as Bobcat machine operator. The locals do all these jobs because training is all in Chinese. We don't need a bobcat machine operator all day, may be only half an hour. We want to get someone who can do other things and then use the machine, but we can't. All workers need to have a Green card. We get approval to do the Green Card directly from here. Green Card is more on laws and rules. A worker needs to know more about site safety. We do an Orange Card which is more safety specific. Half day for office staff. For supervisors, we have a 4-day course on things like hazard assessment, method statement, working at height. We try to cover the things that supervisors need to consider before sending people to work, such as access and working platform. We also run several courses on scaffolding, working at height. For example, in our XXX project, a blue card is needed for marine works. We have the experience and we produce our own training course. We identify all the hazards working at sea, such as getting on and off the water, weather condition, and life jacket. I know they have blue cards, but we give them training again and in three languages. We make sure they understand the basics in their languages. We also have a training manager who is based here full time in our training centre in Mei Foo.

6. Do you have any information about accident cases of ethnic minority construction workers?

Common injuries include falling from height, struck by, electrocution. Falling from height accounted for almost 60% of fatalities. I think it will still continue. Our company safety rules do not allow using ladders for work. Instead, we use working platforms, scaffold, and elevated mobile platform. Using a normal ladder is allowed for access purposes only. I am not saying you must not use ladder. If there is small space and machine cannot get in, then use ladder. We try to think of the method statements and ensure that they do not incorporate ladders as working platforms. If a ladder is used without a specific risk study, the one in charge of the section can face disciplinary action.

We have problem with a subcontractor for finishing works. We don't have electricians. Electricians of the subcontractor use ladders. It is difficult for us to ban their usage of ladder because they have no other equipment. Even we provide to them, they won't use it. They use step ladders without getting off. They should get down, move, and get up again. If they do it safely in this way, they may need to take one or two hours to finish the work, but they want to finish it in ten minutes by not getting down from the ladders. They get pay by the amount of work they do so they want to work quickly rather than safely.

We are working with HKCA, CIC, MTR, and the Trade Unions for a Safety Passport Scheme. When points of the safety passport go down to zero, the worker will be banned from all construction sites for a set period. To go back, the worker needs to get training. Pilot scheme will come out in January.

We have a Nepalese worker in ICU of hospital for two weeks. He fell from the top of the pipe. He should not be on the top of the pipe. Workers have been doing this job for the past ten months. We have system in place and procedures for removing the pipes safely, which they have followed for months, for some reason they did not follow on this occasion and a worker fell and luckily, he will recover.

7. What are the major safety communication problems of ethnic minority workers in construction sites?

Not a major issue for us. We have experience such difficulty in my last assignment in Qatar, where our crane operators were Filipinos who spoke good English, but the riggers were Indians/ Pakistani/ who spoke Arabic and their English were not so good. It took three months to figure out there was a problem. When assigning the workers, we should have picked those workers who can speak English to work together. The same issue does not occur here in xxx. If you get the right Nepalese foreman or supervisor, you can get the best workers. It is important to make sure supervisory people can communicate with the workers.

8. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

Give the training in their own languages. All documentation, training, posters, information should be in their languages. Even the document is written in English, the Nepalese supervisor can tell the workers in Nepali. Most of our Nepalese foreman/supervisors come through the ranks. Most of them start as workers. They improve themselves as they progress. For ethnic minorities, there is always one leader ('big mouth') and the rest will follow. We fairly look after them. Ethnic minority workers will voice out their needs to foremen or supervisors. If the workers find it unsafe, they can say no. Even if the foreman threatens to send the worker home, the worker can go and find the safety officer or me. We have suggestion boxes. We reward good ideas and give safety recognition. To make sure they don't drink, we give them $50 voucher if they pass breath alcohol test. We have enough people to supervisor and check them. We try to encourage them and keep them involved.

We get more attention from the Labour Department than other local companies. The Labour Department did not say anything to safety manager to stop the work on site but send us summons later. It is so difficult to trace the thing after a long time for a big construction site. We don't charge our subcontractors for the training. We treat them the same as our workers. However, those workers from the subcontractors do not get paid. Subcontractors do not pay them because they do not work. Maybe I should charge the subcontractors and pay the workers of the subcontractors.

9. Remarks:

We have two work shifts, sometimes three. Workers work from 8a.m. to 6p.m. There are lunch breaks and other breaks. We will arrange the work so that they do not work in the tunnel for all day. Signage can be in three languages and we use pictograms.

Interviewee B

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Ethnic minority construction workers mainly concentrate on steel bar bending and fixing, metal formworking, metal scaffolding. Some female ethnic minorities work as manual labour. Most of the ethnic minority worker in XXX are Nepalese. Only some are Pakistani. Ethnic minority workers are usually paid about 10% less than their local counterparts. Ethnic minority workers are mainly found in building projects of XXX. There are also some Ethnic Minorities working in civil sites as soil nail worker and tunnel worker. They mainly concentrate on a particular trade because they usually get their job by referral. Ethnic minorities have a strong tie of ethnicity. They live close to each other and help each other. Some of them can listen and speak Cantonese, and a little bit English. However, there are also ethnic minority workers who do not know any Cantonese. Communication with them is a problem. Concentration of ethnic minority worker in particular trades is good because they can get peer support and they can help each other at work. They all have Green Card. They acquire job skills through on-job training and apprenticeship.

2. What are the major safety and health problems faced by ethnic minority workers in construction sites?

Ethnic minority workers face the same safety and health problems as the local workers. Risks of their job depend on the work to be performed. There is no difference between ethnic minority worker and local workers. Most risky works are those involving work at height.

3. What are the current practices in management of safety of ethnic minority workers in construction sites?

No safety management practices are particularly implemented for ethnic minority workers. Common practices for ethnic minorities include translating important safety rules and signage into the home languages of ethnic minorities on site. Labour Department has issued pamphlets in different ethnic minority languages. Training will be conducted in English or Cantonese, depending on the language ability of the ethnic minority workers. Sometimes, an ethnic minority ganger who can speak Cantonese can act as a middleman to pass messages to fellow ethnic minority workers. For a project with particularly large number of ethnic minority workers, subcontractor may need to employ a full-time ethnic minority supervisor. That ethnic minority supervisor will lead morning exercises and tool box talks. Subcontractor will bear the cost. Number of ethnic minority safety officer is limited in Hong Kong. Thus, it is not easy to hire.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

Communication is the major difficulty. For example, message from the management passes to the supervisor may only retain 70%. It is questionable how much of the message could be passed to the ethnic minority workers. Cultural difference is not seen as a problem. They do not often cut corners. Some local workers also cut corners. Ethnic minority workers catch up with the safety standard in Hong Kong by obtaining green card and learn from their peers. Most of them perform well. If they understand the requirement, they will be able to meet the requirement. They are obedient and tend to follow the procedures rather than cut corner.

5. Can you compare safety culture/climate of ethnic minority construction workers with that of local workers?

Safety culture/climate of ethnic minority workers is not different from that of local workers. Ethnic minority workers will comply with safety requirements provided that they understand the requirement. They are obedient and do not tend to skip proper procedures.

6. Can you give any recommendations for improving safety performance for ethnic minority construction workers?

More training. The government should take the lead to publish more pamphlets for ethnic minorities. Occupational Safety and health Council and the Labour Department should consider organizing on-site safety talk. More training courses should be conducted in languages of the ethnic minorities. Employ ethnic minority safety supervisor for better communication.

7. Do you have any information about accident cases of ethnic minority construction workers?

Last year, 7 out of 50 accidents involved ethnic minority workers. The number of ethnic minority workers of the whole company was less than 5%. It is suspected that some accidents were false. Most accidents were back injuries. There was once a case that a worker got his back injured on the first day of work. He called the police and was sent to the hospital. A few days later, he returned with a lawyer. X-ray checking could not show any problem. Civil claims may start at HK$500,000. After negotiation, final settling amount may be HK$200,000. That amount of money may already be good enough for the injured ethnic minority worker to spend for the rest of his life in his home country. This explains why some ethnic minority workers may pretend to be injured. Those suspected to submit false injury claims usually live very close to each other. Occurrences of suspected false accidents of ethnic minority workers deter contractors to employ any ethnic minority worker. Company safety performance will be worsened if an accident is reported no matter the accident is real or not. Legislation tends to protect the rights of the workers. In tender interview, subcontractors will be asked whether they will use ethnic minority for the tendering project.

8. What are the major safety communication problems of ethnic minority workers in construction sites?

Language barrier. Tool box talk and training for new comers will help remove safety communication problems.

9. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

Use interpreter. Use multi-language notice together with pictogram.

10. Other remarks:

Ethnic minority workers are physically strong and tend to be young, from 20 to over 30. They are tough and can stand with hot weather. For safety management, ethnic minority workers do not want to draw special attention of the management and they would like to be treated the same as their local counterparts. It is a dilemma to employ ethnic minority worker or not. If not employ, there would not be enough construction workers. If employ, there is a risk of having higher accident rate which may not all be real injuries.

Interviewee C

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Ethnic minority workers are mainly manual labour. It is easier for them to enter the industry as manual labour because no special skill is required. Since most of them are manual labour, their works are not that risky. For example, manual handling, soil excavation, loading of materials etc. Unless they stand on the edge which exposes them to the risk of fall from height, their work tasks are not risky to result in fatality. They may be more susceptible to injuries but not fatalities because they are less involved in risky and high-skilled tasks. They are mainly involved in hand or foot injuries. Most of the ethnic minority workers are Nepalese and Pakistani. Indian and Vietnamese are relatively few. For Nepalese workers, some of them were formerly Gurkhas. They are strong and obedient.

2. What are the major safety and health problems faced by ethnic minority workers in construction sites?

There are communication problems. Local workers may be reluctant to explain the work to ethnic minority workers in great details. In a morning prayer, there might not be translation for the ethnic minority workers. Thus, the ethnic minority workers may not be able to know what they should pay attention to for the work of that particular day. Sometimes, the ganger will partly translate important points. Perhaps, the ethnic minority workers are subject to more minor injuries because they are hard working. The amount of work they performed per hour is often greater than local workers. With a higher work intensity and exposure, their chances of getting injured also increase. Only a few of them can speak Cantonese. The ganger usually knows English, but the ganger cannot explain everything for safety in detail. Hand and food injuries are common for ethnic minority workers. Ethnic minority workers as manual labours usually take up different types of work assigned to them in the morning. They will then be briefed for the difficulty and danger involved in the tasks. They usually perform the task in small groups.

3. What are the current practices in management of safety of ethnic minority workers in construction sites?

Yes. For example, use English in training and induction. Labour Department and the Construction Industry Council have prepared posters, CDs in the languages of the ethnic minorities. However, more could be done on translating warning signs and posters into the languages of ethnic minorities. At site level, we normally depend on the ganger for translation. Senior management communicates with the ganger in English or Chinese and then the ganger communicates with the ethnic minority workers in their own languages. It really depends on the ganger to translate the message

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

Because of language barrier, it is difficult to give instant and on the spot warning to ethnic minority workers. The only way is gesture. To break the language barrier, a ganger acts as a communication media between the management and the ethnic minority workers. However, sometimes local safety supervisor does not know the technical term in English. He needs to find out the English term and then tell the ganger. Posters and meeting minutes are all in Chinese. More training in the language of the ethnic minorities is needed. Communication barrier is the major difficulty. If the ethnic minority workers know what to do, they tend to obey and follow the instructions, but this is not the case for local workers. Ethnic minority workers are obedient to authority and power. Performance of ethnic minorities could be very extreme: some are very hard working but some are not. In contrast, performance of local workers is more or less the same. We need to rely on the ganger to control them.

For Muslims, they need to worship five times a day, two to three times would clash with their works. Their religious practice may need to be considered when making work arrangements. For example, during their fasting month, we need to pay attention to their health conditions.

5. Can you compare safety culture/climate of ethnic minority construction workers with that of local workers?

For ethnic minority workers, after you teach them, they will follow the instructions. However, local workers do not follow although they know what to do. For example, workers do not want to wear hard hats in an indoor jobsite, thinking that it is not dangerous. For ethnic minority, you teach them then they will follow. For local workers, you teach them then you will need to monitor and check.

6. Can you give any recommendations for improving safety performance for ethnic minority construction workers?

Ganger should be present on the site every day. For example, in a morning prayer, they can help to translate important message to the ethnic minority workers, telling them to be aware of potential danger of the work that day. Religious practices of ethnic minority should better cope with Hong Kong culture. Warning signs written in ethnic minority languages are the most effective. Safety CDs and tool box talk should be available in ethnic minority languages. Perhaps due to limited resources, all contents of safety CDs could not be produced in ethnic minority languages, but it would be good if at least the conclusion part can be in ethnic minority languages.

The presence of an ethnic minority safety officer will be beneficial to site safety. However, only a few ethnic minority safety officers are available in Hong Kong. It would be good to encourage ethnic minorities to receive training and get proper qualification to become safety officers. However, to the employer, it would be better to employ a local safety officer but rely on the ganger for translation.

Safety supervisor only needs to take safety training for six days. To become a safety officer, there are relevant courses offered in Open University, the Hong Kong Polytechnic University, Hong Kong University of Science and Technology. Besides, Construction Industry Council has a one-year full-time and a two-year part-time course for safety officers. Graduates need to open a log book and accumulate necessary site experience. After two years, the candidate might send the log book for Labour Department's assessment so as to be a Registered Safety Officer. For those who possess the academic qualification but not yet gain enough site experience for registered safety officers, they may temporarily act as safety supervisors. Their salary is much lower than a registered safety officer.

Upon safety inspection, the Labour Department mainly deal with the project manager or safety officer but not directly with ethnic minority workers. Thus, it is not necessary for Labour Department to recruit ethnic minority safety officer/inspector.

7. Do you have any information about accident cases of ethnic minority construction workers?

Only come across minor injuries, such as cutting fingers, eye being hurt without goggle.

8. What are the major safety communication problems of ethnic minority workers in construction sites?

Mainly gestures. In case of emergency, only Chinese language is used. The ethnic minority workers only listen to their ganger but not others. Some of them cannot speak English. To break the language barrier, communication mainly relies on the ganger. Ethnic minority workers will tell the ganger if they face any safety problem. However, this seldom occurs because they are normally assigned with simple tasks without risk.

9. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

Ganger is important. Language also matters. Posters, CDs, and pamphlets should be available in English or ethnic minority languages. More trade specific tool box talk and Green Card training for ethnic minorities in their own languages should be available.

10. Other remarks:

Labour Department and Construction Industry Council can put more effort to improve safety of ethnic minority. Fatality rate of ethnic minority should not be worse than that of local workers. It is because they are mainly daily wage workers and they do not need to hurry to finish the job. In contrast, formwork and steel bar fixing works are sometimes paid by piecemeal rate. The faster you perform, the more you can earn. When in a hurry, accident may occur.

Interviewee D

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Basically, they are general labours. They can do anything asked by foremen, senior management and engineers. The reason ethnic minority workers are asked to do all things is that they are easier to be controlled than the Chinese workers. The Nepalese and Indian people tend to be loyal to their employers and don't care about safety that much. In XXX, 80% of them are general workers; few are scaffolders, plant operators such as excavators. For the subcontractors, some ethnic minorities are steel workers, carpenters and scaffolders (bamboo is not a lot, mainly metal). Few of them are learning steel fixing, but the bar bending machines are all handled by Chinese in this project now. Most ethnic minority workers on this site are Nepalese. There are very few Pakistan workers and most of them work as security guards. Manual handling is not that dangerous, mainly back problems. Nepalese are strong built and can cope with hard labour. It depends on the foreman and superintendent. Some allow workers to take rest after working for some time, but some only ask workers to work continuously.

2. What are the major safety and health problems faced by ethnic minority workers in construction sites?

As we are working in construction site, we have to be very careful first. If we take ourselves, it should be safe on site, and especially this is a summer season we have to drink more water. I don't drink alcohol, but I require my colleagues not to drink. They should drink more water in construction site. It will help us make safe. They listen to me. I request them to not smoke, drink and gamble on site during the work. Sometimes we work together with local workers and sometime we are working in Nepalese group of people.

When safety people see workers working without PPE (e.g. eye protection, hand gloves), they will stop the work and tell the ethnic minority workers to get proper PPE from the foremen. However, the ethnic minority workers found it difficult to ask foremen for their PPE. When the foremen receive the ethnic minority workers' requests (complaints), the foreman may think these workers are very fussy and they are complaining very minor issues. The ethnic minority workers are afraid of being fired by the foremen over these minor issues.

Follow up question: Is this because of communication?

Communication plays 70% percent.

Major emphasis of safety toolbox talks or safety training goes directly to local Chinese people, seldom for the ethnic minorities. I've never seen senior management pay attention to safety of ethnic minority workers. If I were the manager, I would have grouped all the workers both Chinese and non-Chinese to have safety training altogether. In this project, we try to group all non-Chinese people together and give them safety training. The other thing is that the Labour Department, which oversees all the construction sites in Hong Kong, does not have any non-Chinese safety officer. There are, however, lots of non-Chinese workers in Hong Kong. Signage and notice are written in English and Chinese but not languages for ethnic minorities. Although the Labour Department has made some effort, it's still not enough. Last time I went to a safety talk held by Construction Industry Council (CIC) for ethnic minority workers. The Chairman delivered a speech in Cantonese. The interpreter did not accurately translate and convey the message to the audience ethnic minority workers.

Follow up question: Do you think you can help those ethnic minority workers to have a better safety situation?

My job as a safety officer is to look after everyone who comes to our site, not only ethnic minorities. I don't discriminate anyone, but other people are not doing the same thing. The Labour Department just talk, like politicians. If the Labour Department really cares about safety of the ethnic minority workers, they should hire some ethnic minority safety officers.

Follow up question: Are ethnic minority workers paid less than Chinese workers?

Yes. There are discriminations in Hong Kong. Mindset has to be changed.

3. What are the current practices in management of safety of ethnic minority workers in construction sites?

In the morning, we conduct a safety briefing on site. In this project, we have one safety officer and two safety supervisors who speak Nepalese. We specifically target the ethnic minority workers. There are 35 Nepalese and 3 Pakistani in this project. When the Chinese safety officer conducts a safety briefing in Chinese, I will translate. For specific training provided to workers, Chinese workers and ethnic minority workers will be separated. Chinese workers will be led by Chinese safety officer whereas ethnic minority workers will be led by me or Nepalese safety supervisors. Whenever we receive an accident case alert from the Labour Department or from the newspapers, we will translate and hand them out to the workers.

I don't think so they are treating the EM differently. But sometimes we are treated as because we are EM. Sometimes we have to mix up. During work, we work with Chinese workers, and we work together for cooperation. I don't think they are treating us differently, but sometimes some people have that kind of attitude, some of them don't think like that. Because especially the top management is not treating us differently because if they treat us as EM then we may not have a chance to work in the construction industry. But we have a basic right to work because we have lived here in this city living here for more than fifteen years. We have right to do everything here. We have chance and right, and we don't give them like that. When the company have some important, sometimes they treat us like that, but not regularly. There is not that kind of differences between the minority and the general workers in engaging the interaction. For example, every year, one time there is a social gathering party. At that time, they invite all of us not only local people. Most of us are working on daily wages.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

The first problem is communication and language barriers. The second one is that Nepalese people are very loyal to their superior. What the foreman asks them to do, whether safe or unsafe, they will do it. Ethnic minority workers might think if I don't do what the foreman says, I will get fired. If I lose my job, there is no one to earn money for the family. For local people, they can argue with the foreman and they can get another job easily if they are fired. They have friends and relatives working. For ethnic minority, it is very difficult for them to find another job in other job sites or trades. Jobs advertised in the Job Search Centres of Labour Department only target local people but not ethnic minorities. Ethnic minority workers get their job by referral from friends. For example, I come here, and I bring our two safety supervisors here. I also recommend some workers to our foremen and superintendents because I know they are hardworking. To me, I studied diploma in occupational safety and health at XXX. My uncle was a safety manager in XXX before. He asked me to join XXX. I join nearly three years. As a safety officer, the saddest thing for me is that workers know it is unsafe, but they still do it. Why? Because someone at senior level pushes them to finish the job. That's the problem. Safety culture has been improved a lot. They used to allow a wooden ladder to be used in construction site but now cannot. However, mind-set of the local people still has to be changed. Young guys are for safety, but the old guys are for production. Workers still don't care about safety because they need to finish their work. A lot must be done. If the government really wants to improve safety, it is not about preparing more posters but face-to-face talk to workers and more interaction with these workers. This is not only the job of the government but also senior management.

If you are not feeling well, and you feel sick, you are not going to the construction site. We cannot get the salary, because this is daily basis. If we come, we can get the salary. If we don't come, we cannot get our salary. If danger happened in site, and we got injured, we will go to see doctor. We can get 80% of the compensation. This is the rule from the labour department. It's same. There's no difference. Especially, the main contractors are using two languages like in Chinese and English. Some of these are only in Chinese. We cannot understand them all. Sometimes we got difficulties in understanding rules and regulations. We hope the contractor can change the safety notices in English, or in Nepalese, which is better to understand for more workers. There are sometimes some problems if some instructions are only in Chinese, as we cannot read Chinese, especially for the minorities. But nowadays in construction sites some of the instructions are in English.

Follow up question: How about the middle management?

Message from senior management could be completely different when it reaches the frontline workers. What the project director says is like this but in the end, it is not like this.

Follow up question: Do you think the ethnic minority workers have enough safety knowledge for their job?

Yes, they have safety knowledge. Before a worker enters construction industry, they need to have Green Card, Workers registration Card, Trade specific training, Zero harm, and separate safety induction. A lot of knowledge passes to them. Some of them are illiterate, not well educated. How they grasp the information is a different story. I think they know. In some cases, it is not me telling them. It is by trade, when you work in the trade for 10 years, you know it is not safe. Everyone should know basic safety. Otherwise they are not qualified to work in construction industry.

Follow up question: Are most Nepalese workers born in Hong Kong?

Some of them are. I've come across some who can speak fluent Cantonese. When ethnic minorities are born here, they can go to local schools. They can write and speak very good Chinese. Things are going better.

5. Can you compare safety culture/climate of ethnic minority construction workers with that of local workers?

Yes, a lot of difference. Actually, it all depends on the safety officer you have on the job. I am a safety officer. If I sit in the office and I don't go out to the site, it is another story. In this site, we have 7 safety teams. We always go around. Workers know that the safety people will come, at least, they will try to be safe. Try to avoid unsafe condition and unsafe acts. Sometimes local workers, but not ethnic minority workers, will ignore us. I personally have a few arguments with local workers. They pretended to beat me and used bad language. It depends on how active the safety team is. In this job, we are very good, I must say. We petrol every time. We go around and around. Ethnic minorities are afraid of losing their job, but local people are not because they can find another job easily. The advantages of the local people are they have their homes, savings, and family to support them. For ethnic minorities, most of them rent flats, single in Hong Kong. Money also plays a part. Safety may not be a priority to local people, but it is a priority to ethnic minorities. However, it all depends on the safety officer/ foreman who gives instructions to the workers.

6. Can you give any recommendations for improving safety performance for ethnic minority construction workers?

Employ the same language speaking safety supervisors/officers in each individual construction company and also in the Labour Department. In this site, we have 50 or more Nepalese and Pakistani workers. Why not employ safety supervisor who can speak the same language? It is not necessary a safety officer. In our construction site all the trainings are carried out in Chinese and English. Although we have improved but I would suggest that the trainings should be conducted in English or in our local languages. Gangers are used to translate the safety instructions to groups.

Follow up question: Is it difficult to hire one because very few safety supervisors are ethnic minority?

No, it isn't. When I did my diploma, there were around 10 ethnic minorities. I think nowadays there are more than 30 or 40 ethnic minority people who are involved in safety. The problem may be that the low salary could not attract ethnic minorities work as safety supervisors because they are given less salary than local people. The most they can get for being a safety supervisor is around HKD 15,000 to 18,000 per month but if they work as a construction worker, they will get around HKD 30,000. They prefer to work as construction workers due to comparatively higher salary. I have a friend who is now a registered safety officer. I introduced him to work as a safety supervisor in a company. Before he worked on safety, he got around HKD 30,000.

When he worked as a safety supervisor, he got around HKD 15,000. He had a wife and two children depending on him. If the safety field is paid a lot more, more people will join. Besides, the Labour Department has to do something. I guess we have around 15,000 ethnic minority workers but the Labour Department does not even have one ethnic minority Registered Safety Officer.

7. Do you have any information about accident cases of ethnic minority construction workers?

Recently a female worker got crossed by an excavator when she was sweeping the ground in XXX. The excavator reversed and crushed her to death. Another case was in XXX. A Nepalese foreman was next to an excavator. The operator did not see him, and he was crushed by the ballast of the excavator. In this project, few Nepalese got injured, mainly finger injuries. A few of them had sprains and strains on the ankle and slip and fall hazard.

8. What are the major safety communication problems of ethnic minority workers in construction sites?

Safety briefing/ training mainly uses local language but not ethnic minority language. It must be changed. The change has to be led by senior management but not just safety people. Budget should be separated to train this group of people, giving more opportunities for them to begin other work trades.

Follow up question: If the ethnic minority workers have safety problems, who do they go to?

In this project, they will come to me or safety supervisors, but it seldom happens because they are afraid of losing their jobs. If they complain, I as a safety officer will go to that area and investigate. I will call the foreman and engineer who are in charge of that area. I will relay the message to safety manager. The safety manager will bring the issue to senior management. These people will be in trouble and then the worker will be in trouble. Why did you complain to the safety officer? It is because of culture. We do have a near miss reporting system here, but I've never seen any Nepalese worker coming up to me to report a near miss. We have Appropriation system to reward reporting of incident or accident, but I've not seen that happen. Local Chinese may do it but not the ethnic minority. In the end of the day, ethnic minority are to earn money to send back home. If they do things like that, foreman or superintendent may blacklist them, and they might lose their jobs. It might take them two to three months to find another job.

9. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

The first thing is use their mother tongue language to convey the messages. Converse with them in the same language. The second is to encourage them work safely and to speak up any unsafe conditions. Make the local people and ethnic minority people on the same level of status. If the ethnic minorities are given more authority and energy and more employment opportunities, they will raise their safety level.

10. Other remarks:

Welfare for the ethnic minority workers. For example, in safety lunch meeting only Chinese food was provided. More training opportunities should be given to them to learn other trades rather than manual labour, such as crane operation.

Follow up question: From a previous interview, I was told that ethnic minority workers are mainly steel bar fixers but, in this site, ethnic minority workers are mainly manual labour. Why is there such a big difference on these two sites?

Ethnic minority workers join steel fixing because it pays more, HKD 1,500 a day. Steel fixing requires more manual labour and more hardworking. These specific group of workers need to at least speak basic Cantonese because people in steel fixing companies cannot speak English. They converse in Cantonese. Metal scaffolding work don't need to speak Cantonese. You need to speak English with them. In Hong Kong, Nepalese are well recognized in scaffolding work. They are very good. It is well recognized that Nepalese can erect scaffolders very safe and very fast. For general workers, basically you can instruct them to work by pointing fingers. Language plays an important role.

11. What is the existing communication network structure (Organizational structure of Safety Department)?

The majority is in Chinese. The information from the head office goes to the site, and from the site management goes to the site supervisor like site engineer, foreman, ganger, and frontline workers. The language they use is obviously Cantonese for verbal communication and written communication as well, like pamphlets, posters, safety alert sings are in Chinese. Seldom, we see that communication language is in English. The only situation is that they have foreigners from the U.K. or America working on the site. I seldom see the information is translated into the EM language. But having said that, XXX is trying their best, take me for example, the head office has notices about the safety issues, they have actually hired translator to translate all these things and they will prepare the daft and send this to me to check their translation is correct or not. If I have some comments on that, they will revise them. But when comes to printing them, one thousand will be printed in Chinese, and only 10 or 20 are in translated into EM language. I don't know why they do that, but this is what we have now. When we are working on construction site, we will paint picture, early in the morning the workers will gather around in a certain area. The foreman as in charge of giving requirement for every project. Foreman will give morning briefing, but 99% of that is in Cantonese. Right now, in the construction industry, with emerging number of workforce being South Asia, I don't see that much is being done.

How many workers are working on this site (both local and non-local)?

Currently, only five non-local workers in a total of five hundred workers are working on this site. One of them is scaffolder, two of them are traffic controllers, and two of them are just cleaner. They are all Nepalese. They are directly hired by XXX and working under me. They were a few Pakistanis working through the sub-contractors. They were not working for the entire project duration. They came to complete the job and left.

How about the organization hierarchy like the structure of the safety department?

Basically, the safety manager and director is European and the others team is local Chinese in the safety department. We have a few registered safety officers (RSOs) now registered with the Labour Department, and I think 12 to 15 registered safety officer are Nepalese. Hiring them is very difficult. The reason being that is the language barrier. Even you are in construction industry or have a good CV, it doesn't matter. What matters is that you need to know reference to get a job.

As a safety officer, whom you are reporting to?

Safety manager and the safety manager will be reporting to safety director.

Safety director→safety manager→senior safety officer→safety officer→safety supervisor.

Safety supervisor is the lowest in the hierarchy.

Are safety supervisors ethnic minorities or locals?

Earlier all of them were locals. Only one or two are ethnic minorities safety supervisors. They have studied safety courses of the occupational safety and health. I have seen five of them. First you need to go to the occupational safety and health training courses, then if you have successfully completed the courses, you are given a certificate as safety supervisor. Then you can go to work in any company in construction industry as long as you can get a job. Then you need to take the diploma course with one of the university. After that you need one more year experience working in construction site. After that you can submit your documents to the Labour Department, if you have satisfied their requirements then they may registered as a safety officer. This is a bit lengthy process. Safety supervisors are the lowest position in the safety department, and they are mostly abused by the sub-contractors and workers.

But most of the local workers don't like to attend diploma course because the textbooks are all in English, and the teaching is in Chinese. You need to have a written examination in English. It is very difficult for them to understand, so many people just quit.

Why the teaching is in Chinese?

Because it is hard to find English teacher. For me, I need to do it. Fortunately I can understand few Cantonese, but when I started this diploma course, some of my Nepalese friends who joined the same course, I have to explain them what the lecture is about and what they are saying.

12. What could be an effective communication network structure?

In term of communication related to workers, you need to understand who the key people are. The key people on site are frontline supervisors, foreman who need to be trained. Organization decision in terms of how many workers they have from different nationalities. For example, if there company had 100 Nepalese workers, it's worth having a Nepalese foreman. The contractors, sub-contractors just trying to complete their job without caring if about the workers understanding of safety regulations. I have been in many morning briefings, foreman sit in front, usually local workers are sitting in the front, and the ethnic minority workers are sitting at the back. Some of them are smoking and some are playing on mobile phone. The ones sitting at the back are listening. But when the massage goes from the front to the back, they don't understand 80% of the information the foreman said. So the construction industry needs to improve.

Is there any translator or ganger translating the safety information?

They seldom have this. But it depends on the trades, general workers and skilled workers. Skilled workers like scaffolders. If you will visit the site, I can guarantee to you that 90% of the scaffolders are from Nepal. They have their own ganger or foreman. Because they are not from the main contractor, and they are from the sub-contractor. But for general workers there is no foreman from the EM. Subcontractor has their own foremen. In XXX, we are trying to reduce the barrier, and trying to translate notice into Nepalese, Urdu and Philippine language. We are trying to improve the communication, because communication is very important for performing the day to day operations.

What is the current communication structure?

No, we only have top-down.

13. Whether good safety performance staff has an effective communication structure?

Yes. I agree 100%. For example, I came from Nepal to HK. I was born in Hong Kong, or I married with a woman who is a residence in HK. I came here to have good earning. I can think I am a local as I was born in HK, and a permanent residence here. But the locals think we are outsiders. If I am fortunately hired by this company as a general worker, I will always keep in my mind that I will always be afraid of losing my job, because the foreman can fire me anytime and hire another local worker. So, I need to do everything the foreman will ask me to do. I can say 95% of this thing is happening. This is always South Asian keep in mind. You can go to the Labour Department and see the accidents statistics of South Asian workers, and I can guarantee you 100% of the South Asian injured are told by the officer to work unsafely.

How about the main contractors? They also treating the EMWs differently?

Few contractors are more caring. But most of them they do not treat them well. The equality is only in the policy statement but they are only focusing on the production, production and production. The Labour Department can give warning, suspension or improvement notice and they can also stop the construction work. But still the construction industry is very demand oriented.

14. What are the main communication tools (e.g. mobile phone, body language) and means (language) used by the ethnic minority workers in construction sites?

Main communication is done through morning briefings. XXX is a caring company and is translating safety alerts into different languages. For personal communication, we use mobile phone. Especially site supervisors have Walkie talkie. They can communicate every time and when something happened they talked via this. The language used is Chinese. Because I can speak Cantonese so I passed the message to front-line workers.

15. How frequently safety manager interacts directly with ethnic minority workers? Whether interpreters or translators are used for effective safety communication with ethnic minority workers?

They intend to do a lot interaction with the workers. But there are some language barriers. The safety manager may be from England or Australia. The workers are from India, Nepal or Pakistan. How can they communicate? They are influent in English, and the others are fluent in their local language. I sometimes conduct as an interpreter. It's difficult for English speaking safety manager to communicate with EMWs. Most of the EMWs are not educated. Some are educated. You need to balance them. They didn't interact directly with the front-line workers because this is a very big contractor, and there are so many supervisors, foremen, site managers, etc. We have some problems, or something to ask him, we can find them. They treat fairly. As a ganger we are working as interpreters or translators. In our site, in our group, if something happened, we can communicate easily. If we cannot understand Chinese, our supervisor will find someone who can speak Chinese, English or even Nepalese.

16. What modes (formal and informal) of safety communication are used for ethnic minority workers by the safety manager in construction site? Who will the ethnic minority workers seek help in case of safety problems?

The modes of safety communication for EMWs are obviously informal. There are formal for locals. The EMWs are always seek help from me as a safety officer. If they are lucky to have a safety officer from South Asia. I am not sure whether the other construction sites have South Asian safety officers. But in our site they always seek help from me and my colleagues who are also from South Asia. The toolbox talks in the construction industry are done by the foreman and if the contractors have South Asian foreman then there is no problem. But if they don't have which is in most of the cases they may create communication problem. Formal communication is in English and informal in Cantonese. I cannot read Chinese. When there is an accident happened with Nepalese, they will try to find a Nepalese ganger or supervisor. Use language translation like this.

17. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?

The safety trainings in paper are conducted in EM native languages, such as safety policy and safety plans must be conducted in EM languages. But safety training officer are always locals, and they cannot speak EM native languages. The trainings are conducted in English and Chinese. But when they know the number of Nepalese workers who cannot speak Chinese or English then they arrange the trainings in our own language. Most of EMWs cannot read English. XXX has hired someone to translate the materials into EM native languages. As for me, I will translate them. But what happened in translation is that when you translate “excavation” into my own language, it will be very hard to understand, because I never went to school. The problem is that if you translate the excavation into Nepalese, it is hard to understand.

What are the major safety communication problems of ethnic minority workers when communicating with local co-workers in construction sites?

Sometimes there are language (communication) problems. I must say that we can speak Cantonese but we are not fluent which we cannot understand. They are saying something else, and we understand differently.

18. What measures should be taken to improve safety communication of ethnic minority workers in construction site?

A lot of things need to be done. Starting from the frontline supervision, for example hire EM foreman. If you cannot find someone who have the qualification, then find some frontline workers, train them and spend some time and money on them. Because at the end of the day as an organization you will benefit from this capacity building program. As for the safety management, to do what you say, say what you do, not only in paper.

We have to learn Cantonese, because this is China, this is Hong Kong. For example, if foreigners are coming to your country, they have to learn your local language. As we are here, we need to improve our Cantonese and English, especially who wants to work in construction site.

Interviewee E

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Ethnic minority workers are involved in a number of trades, such as excavation, steel formwork and falsework, bamboo scaffold erection. They do not concentrate in any particular trade. In general, they involve less in highly skilled trades, such as steel bending, and wooden formwork. In XXX, approximately the same number of ethnic minority workers is involved in building and civil engineering jobs respectively. In respect to safety, construction industry itself is high risk, dirty and difficult. However, if compare safety performance of the local workers with that of the ethnic minority workers, I don't think there is any difference. As a company, the same safety facilities are provided to both the local workers and ethnic minority workers.

We do not have data about the exact ethnicity of our South Asian workers. We do not classify them and do not discriminate them. Our company has around 300 to 400 direct labour, of which around 10 to 20 are ethnic minority workers, making up around 5% of the direct workforce. Subcontractors in general have around 10% of ethnic minority workers.

Currently, there is very limited construction training course for ethnic minority workers. Some trades require workers to have licence, such as truck load driver, and crane operator. Since no training courses of these trades are provided to ethnic minority workers, they cannot get relevant trade test licences. Hence, they cannot work in these trades. For government projects, Housing Authority projects, and Housing Society projects, trade test certificates are required for specific trades. Ethnic minority workers have no such certificates and they cannot work in those trades.

2. What are the major safety and health problems faced by ethnic minority workers in construction sites?

Some work practices of ethnic minority workers in their home countries may be different from that of Hong Kong. Language is the greatest problem. To give an example, when local workers tried to use gestures to stop the ethnic minority workers from entering a crane operation zone, the ethnic minority worker misunderstood. He was then struck by the materials being transported. Safety practices for different trades are equally applicable to every worker, no matter local or ethnic minority workers.

Language is the problem when injury occurs. We are dealing with a case that an ethnic minority worker had back injury. When we wanted to ask him about the accident, he said he could not understand Cantonese and asked us to talk to his lawyer. However, other co-workers expressed that they could communicate with that ethnic minority worker in Cantonese at work. This is not the unique case in our company. I've heard from the Hong Kong Construction Association and other construction practitioners that some ethnic minority workers are aggressive in claiming injury compensation. I can only say that there are bad as well as good people in the group.

3. What are the current practices in management of safety of ethnic minority workers in construction sites?

We do not discriminate the ethnic minority workers but at the same time we do not deliberately raise their status. We have limitations. We cannot conduct safety training in the languages of the ethnic minority workers. We basically use Chinese and English to conduct training. For one time in a high risk and complicated project, we employed a Nepalese translator to brief the ethnic minority workers. That project involved lifting parts of a bridge which were very heavy. Many ethnic minority workers were involved and worked together with riggers. Since this practice involves resource inputs, it is for high risk job only. For low skill works, we don't adopt such practice. Instead, we ask the Nepalese ganger to translate to the Nepalese workers. In case the ganger of the subcontractor is not Nepalese but local Chinese, we will ask the workers who's English or Chinese is relatively better. Usually, there will be one ethnic minority worker standing out to represent the fellow workers. He will then help to translate or reflect their needs to the management. So far it works.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

I don't see any difficulties. They understand clearly safety rules and regulations. Ethnic minority workers are even more active in using PPE than local workers. They are more obedient. The majority of ethnic minority workers are good. They can meet our safety requirements. When the ethnic minority workers find any problem, they will voice out through their gangers. We appreciate this because we don't want to see any injury. More communication is needed. It is better to have an agreed construction method statement or procedures rather than leave it for the workers to decide.

Wages are the same for the local and the ethnic minority workers. Ethnic minority workers will not accept if they are paid less.

5. Can you compare safety culture/climate of ethnic minority construction workers with that of local workers?

Problems of ethnic minority workers lie on the mastering of skills. They are actually more willing to use PPE and more obedient to safety practices then local workers. Skilled local worker are too confident with their skills and they are more willing to take risks. When you tell them to comply with safety rules, they will tell you they have followed the practice for many year and has been okay. For ethnic minority workers, they are not familiar with local practice of the construction industry. They are more willing to listen and learn. I can tell that safety performance of ethnic minority workers is not worse than local workers but even better.

I cannot see cultural difference is a problem. They follow the same rest and break schedule with that of the local workers. They actively participate in some initiative activities. They join together with the local workers to enjoy herbal tea. They also join tea party to cut roast piglet. I can see that they are active and willing to work hard because in the long run they can earn more.

6. Can you give any recommendations for improving safety performance for ethnic minority construction workers?

CICTA should provide more training courses for the ethnic minority workers to improve their skills. This will help the overall development of the construction industry. I know CICTA may have difficulty in finding suitable instructor who can speak the ethnic minority language. However, if these ethnic minority workers cannot acquire more training, development of the construction industry will be hindered. We as a contractor cannot issue trade test licence to workers. CICTA is in the best position to do so.

I know there are two Nepalese safety officers of XXX doing a safety audit course in XXX. The course is conducted in English. They are skilful in metal scaffold and formwork erection. They were born and raised in Hong Kong with good command of Chinese and English. I hope they will pass safety messages to their fellow ethnic minority workers. I think the greatest challenge now is how to improve the skill level of ethnic minority workers.

7. Do you have any information about accident cases of ethnic minority construction workers?

I cannot see any significant difference of injuries between ethnic minority workers and local workers. Some ethnic minority workers have problems but so do some of the locals. I cannot see any obvious safety problems attributable to ethnicity of the ethnic minority workers. We appreciate their participation in our construction sites. I've heard from a few contracting companies that some ethnic minority workers do have problems. In our case, we will try to use our own resources to resolve them.

Ethnic minority workers are mainly involved in minor injuries. We have around 4000 workers on site daily. Our own direct labour accounts for around 400. Causal workers directly employed by our company have the highest injury rates. Subcontractors will sublet the job to a gang of workers. When these workers have finger injuries, they will usually go to the first aid room for treatment and then continue their work because they are paid by piece rate. However, when our workers have injuries, they will immediately report their injuries because they enjoy good fringe benefits of the company. That explains the difference.

8. What are the major safety communication problems of ethnic minority workers in construction sites?

Language is the problem. The government should provide free Chinese course for new immigrants. This will help them integrate to the society of Hong Kong.

Company safety messages are transmitted through notices and training. We have site safety cycle, morning exercise, morning briefing. Although these are mainly in Chinese or English, the ganger is usually present and he will translate. Notices are in three languages, Chinese, English and Nepalese. We also try to use pictorials and method statements with graphics. We also have notice board displaying safety information and tool box training. For particularly dangerous work, we use interpreter. For example, we had one time erected a footbridge for a XXX project in XXX. Blocks of the footbridge are over 100 tons each. Subcontractor told us that a group of Nepalese workers will be involved. We then used a Nepalese interpreter to tell them the lifting point and check the lifting gear. They were good and worked overnight.

9. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

Language. The Hong Kong government should offer Chinese courses for the ethnic minorities. CICTA should provide more training to improve skills of the ethnic minority workers. If they can only participate in low-skilled tasks, it is a waste to our construction industry. Development of the construction industry will be hindered.

10. Other remarks:

I really appreciate the obedience and self-discipline of ethnic minority workers. Hope the Development Bureau and Construction Industry Council will have more promotion to attract them to join the industry.

Interviewee F

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Ethnic minority workers mainly participate in tunnel projects which are difficult to recruit local workers. This is because working in tunnel projects are harder than working in building projects. Local workers do not want to join if they can choose. Say a project with 1,000 workers, half of them could be ethnic minorities. Relatively few ethnic minority workers work in building projects because training for formworking and steel fixing takes longer time to train and there are communication problems between ethnic minorities and local trade masters who can only speak Cantonese.

Mostly of them are Nepalese but there are some Pakistani, Indian or even African. They usually work as manual labour. Only a few of them are on specific trades. To perform specific trades, they need to have licence and the expertise. However, relevant skills training in English is limited in Hong Kong. Relevant courses are few and it is difficult to recruit teachers for these courses. Currently, XXX has three tunnel projects. About one-third or one-fourth of the workers in these tunnel projects are ethnic minorities. Approximately, about 1,000 ethnic minority workers (mainly Nepalese, Pakistani, and Indian) in total.

Safety awareness depends on experience and training. It relies heavily on frontline supervisors. We have Nepalese frontline supervisors. They can do the translation and they can immediately stop work when noticing danger. We have Nepalese foremen, supervisors, and superintendents. These ethnic minority frontline supervisors are vital to the running of projects with ethnic minorities. Even there is English training course, it is doubtful how much English they can understand. They may say “yes”, but the English they know may only be “yes”. To help ethnic minority workers to understand safety procedures, we also have two Nepalese safety officers. They help to train the ethnic minority workers in Nepalese. Not only encourage ethnic minority workers to join the construction industry, but also how to properly train ethnic minority supervisors and safety officers is an important issue deserving further investigation. The government may successfully encourage ethnic minorities to join the construction industry but how they can communicate with supervisory level is important. In Hong Kong, there are day works (like agents) provide labour source. Some are specialized in providing Nepalese labour. The same recruitment requirements apply to both local and Nepalese safety officers. They must be registered and familiar with local law and construction practice. They may have experience in other countries. Not understand Chinese is not a problem.

2. What are the major safety and health problems faced by ethnic minority workers in construction sites?

Their safety awareness is not high. We need to do more, for example, explain to them how to use the equipment. Safety of ethnic minority workers is not much different from that of the local ones. Based on a recent health survey of the company, we found that ethnic minority workers started to have high blood pressure problem much younger than that of the local ones. Ethnic minority workers were found to have high blood pressure as young as in their 30s but for local workers usually around 40s to 50s. This may be due to their diet. Although health may not have direct effect to safety, high blood pressure can easily lead to heart disease. It is dangerous for them as well as others if the ethnic minority workers have heart attack when performing their work, e.g. plant and machinery operation. XXX may also have health data of ethnic minority workers because most of their tunnel works employ ethnic minorities. Tunnel works require 12-hour work shift, site environment is not as good as other building works. Tunnel project is not the priority of local workers. Wages of ethnic minority is the same as that of local workers.

3. What are the current practices in management of safety of ethnic minority workers in construction sites?

No. Safety behaviours of ethnic minority workers are not different from that of local workers. The most important thing is to give them necessary safety information and effectively communicate with them. No extra procedures and measures are targeted to them. Posters and notices are in English, Chinese and Nepalese depending on ethnicity of the workers on site. In case ethnic minority workers cannot listen to English, the Nepalese supervisor will explain to them. For tool box meeting, ethnic minority workers will follow their foremen of their ethnicity. For morning briefing, it is difficult to conduct in separate sessions. Depending on the majority of the workers, English or Nepalese could be used in tunnel projects.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

No. The most important thing is let them understand the safety regulations. If they don’t understand, they cannot comply. Some of the Nepalese workers were formerly

Gurkhas. They are disciplined and obedient, sometimes even better than local workers. The greatest difficulty is overcoming the communication barrier. We have ethnic minority workers in the past 10 years, of course, the proportion of ethnic minority workers has sharply increased in the recent two to three years. We have employed ethnic minority supervisors and safety officers for a long time. Our difficulty in communicating with ethnic minority workers is not that great. Since 2005, we have Nepalese supervisors and they have helped to train gangers to become foremen. Over the years, we have trained and maintained a group of Nepalese supervisory staff. Message can be passed to workers. Two years ago, we started to employ Nepalese safety officer but before that we have Nepalese safety supervisor. Since safety supervisors work on site, they can communicate well with ethnic minority workers. It is important to attract this group of ethnic minority supervisory staff. They need to understand English, Nepal and some of them can even understand Chinese. Middle supervisory level is important. Without them nothing can be done. Every tunnel project has at least one Nepalese safety supervisor. We provide sponsor and training for safety supervisor to become safety officer. It is an asset for our company to have a safety supervisor becoming a safety officer. Physical work of safety supervisor is not as hard as a worker. Safety supervisor has a career development to become safety officer while general construction workers do not. Safety officer can earn HKD 50,000. However, for general workers, when the market is not good, their wages will decrease.

5. Can you compare safety culture/climate of ethnic minority construction workers with that of local workers?

For local workers aged 40 -50, they think that they have followed the practice for more than 20 years. They do not need to change. They do not need to be trained. For ethnic minority workers, they may be new to the construction industry but they are willing to learn and to be taught. So it is difficult to say which group is better. We just need our workers to know very basic safety, not something difficult. The most important thing is make sure that know the information.

6. Can you give any recommendations for improving safety performance for ethnic minority construction workers?

Government should put more resources. Normally a worker needs to wait for three months to attend a training course. This is too long. In three months, he may have already got injured. More resources should be put on safety training, no matter in English, Chinese or language of ethnic minority.

To help ethnic minority to integrate into the construction industry, there should be a career path for them, from worker to ganger, foreman, and then supervisor. If just one company does this, they cannot integrate into the industry and the society.

7. Do you have any information about accident cases of ethnic minority construction workers?

Accident rate is similar for both local and ethnic minority workers. Our accident analysis focuses on nature of accident rather than ethnicity of worker. Most common accidents are finger injuries and hand injuries. We do not have a separate analysis for ethnic minority and local workers. We focus on finding the root cause of the accident.

8. What are the major safety communication problems of ethnic minority workers in construction sites?

Posters and cartoons. Cartoons in English, Chinese and Nepalese are produced to facilitate accident case sharing and distributed to workers on site. We don't miss any group unless workers of a particular ethnicity is really too few. Whenever we prepare poster or training, we use these three languages.

There are two levels of communication. At corporate level, Executive General Manager or I (Safety Manager) will send the information to Project leader/ manager. Project manager will then disseminate the information to the team. The information includes corporate training course, incident alert, publications, and pamphlets. At project level, safety information is disseminated through safety meeting, induction training etc.

Ethnic minority workers will voice out if they find something wrong. For example, they gave feedback on wrong written Nepalese translation from English. They will voice out if you provide a channel for them. The project leader must be visible on site and has positive attitude to suggestions of workers, thank them and follow up with their requests/suggestions.

9. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

Resources. A group of supervisor staff should be able to communicate with ethnic minority workers. Welcome suggestions. Open communication and positive feedback.

10. Other remarks:

Not aware of any special arrangement needed to cope with religious practice of ethnic minority workers.

Interviewee G

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Currently they are working in different trades as general workers, metal scaffolding, tunnelling and road repair works etc. Earlier, the Nepalese workers were working in metal scaffolding and metal formworks but gradually minority workers working for the road work projects as semi-skilled general workers. Well there is no specific effect to their safety performance whether those are local or non-local Chinese workers. No matter which nationality workers belongs to, if there are clear instructions for tunnel workers then there would be less communication problems. Sometimes a leader is working as a bridge between the local and non-local Chinese workers.

2. What are the major safety and health problems experienced by ethnic minority workers in construction sites?

We don't think there are major problems apart from communication.

3. What are the current practices in management of safety of ethnic minority workers in construction sites? (any different treatment for ethnic minority workers)

The practice is same for both local and non-local workers. The training material by OSHC is also translated into three major languages i.e. Chinese, English and Nepalese. But we don't know about other languages.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

I think if they are unclear about the safety instructions then obviously there could difficulties to comply with safety rules and regulations and also depend upon where they come from? If they don't have any working experience at their home country and also they might have different culture then they have to adjust themselves in the local environment. But currently some of these workers are born in HK and they can speak local language. Even for Nepalese workers if they are the 2nd or 3rd generation living in HK, they can speak local language but they might be unable to read and write the local language.

5. Can you compare safety behaviour/attitude of ethnic minority construction workers with that of local workers?

It will be difficult for me to answer this question. But there are some instances observed from the minority workers for the work injury compensation especially in the early days of contract. They just disappear from the work and send back the medical certificate and a letter from solicitor for work injury compensation to their employer. We do have similar kind of problems from the local workers as well. For injuries, if you got injured during the course of work you will get paid 4/5th of the earnings as compensation.

6. Can you give any recommendations for improving safety performance of the ethnic minority construction workers?

We will recommend similar kind of recommendations for both local and non-local workers. The non-local workers should be provided adequate training with good communication skills. The training must be proper and the message must get attention. The message must be clear either in English or in the ethnic minority language. Proper guidance is needed to all workers especially the new workers both local and non-local. Pay particular attention to those who might not be able to understand the local dialects and should make sure that all understand the training.

7. Do you have any information about accident cases of ethnic minority construction workers?

Sorry we do have information about accidents cases but we cannot share that information.

8. What is the existing communication network structure?

9. What could be an effective communication network structure?

10. What are the main communication tools (e.g. mobile phone, body language) and means (language) used by ethnic minority workers in construction sites?

If those workers can understand the local language then verbal communication is very easy otherwise there might be graphical/pictogram.

11. How frequently safety manager interacts directly with ethnic minority workers? Whether interpreters or translators are used for effective safety communication with ethnic minority workers?

I am not working in the construction site so cannot provide you much information.

12. What modes (formal and informal) of safety communication are used for ethnic minority workers by the safety manager in construction site? Who will the ethnic minority workers seek help in case of safety problems?

When they attend the safety training on site, the minority workers can sit together with the local workers, and if they don’t, they need an interpreter in order to get on with the training. You can get more information from site safety personnel.

13. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?

It depends on the number of ethnic minority workers working in that construction site. If there are more workers than those might be represented by the leader and he conveys the message to ethnic workers. OSHC has produced training material into different languages.

Interviewee H

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

They are usually worked as general labourers so that they may have difficulty to apprehend safety instructions written in Chinese or English. They may have difficulty to apprehend safety instructions written in Chinese or English and therefore may not perform very well in safety performance.

2. What are the major safety and health problems experienced by ethnic minority workers in construction sites?

The answer is the communication problem and the not understanding of Pakistani, Nepalese or China men. Nowadays even people from China, so-called Hong Kongnese have different culture. I am surprised to see that happens in Hong Kong, because the parents of those Hong Kongnese came from mainland in China. My parents came from mainland in China in 49. Language barrier, both verbal and written, is the major safety and health problems confronting the ethnic minority workers on constructions sites. (Any problems associated with the cultural difference such as diet.) Religious practices of Muslin of some ethnic minority, such as fasting during Ramadan might affect their physical conditions to cope with the demand of the work.

3. What are the current practices in management of safety of ethnic minority workers in construction sites? (any different treatment for ethnic minority workers)

Majority of them are labourer. I have seen some Nepalese, they have their leaders. All the contractors or sub-contractors directly work and deal with their leader, and the leader will also work as a translator. The majority of contractors in the construction field they only deal with the team leader. The team leader may speak and fluent in their native language, as their parents were in Nepal before, or they have lived in HK for a long time. Some of the so-called HK born Nepalese, they have problems. When they were young, they were sent back to Nepal, but their parents have to work here in HK and they do not have time to take care of their kids. When they were 18, they came back to HK. They know little about Hong Kong, Cantonese and cannot understand Chinese instruction. The contractor is urged provide translator to assist in bridging the language barrier so that the minority workers are able to fully understand all the safety measures on site.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

Communication to the minority workers is the main difficulty. Some minority workers speak little English and Chinese; hence, they cannot fully understand all the requirements of the safety rule and regulations. Some minority workers speak little English and Chinese; hence, they cannot fully understand all the requirements of the safety rule and regulations. Also, they might not fully express themselves in reporting of near-miss and other potential hazard hence becoming passive in safety participation.

5. Can you compare safety behaviour/attitude of ethnic minority construction workers with that of local workers?

We never did comparison on the basic culture. What expected of safety council is SEI under OHSE. Basically the majority of the so-called Chinese workers in HK construction industry have the rules from China. They came from China. I have seen the HK workers have the cultural difference when working with non-local workers. Currently in Hong Kong, the local workers are over or around 55, because the construction industry grew up and went down. In 1997, when the airport was build, the construction industry has gone rocketed high. At that time, the majority of the construction workers were from China. The local people wanted to be graduated from universities, and they wanted to have a white collar job. They don't want to go to the construction site. At that time, there are so many HK people who don't like to work in construction site, so they employed people from China. The workers from north part of China are taller. A lot of them are manual handle workers. All their parents like their children to be engineer, architect, officer or lawyer, and they don't like their children going to construction site. One true story is that one who got kicked out of the USP University from science technology from HK, and then he joined the construction company. However after two weeks, he would rather to be a salesman instead of working in construction site. Nowadays the most of the guys can earn 20,000 to 30,000 per month. As he is selling mobile phones, he gets not so much money. However he said he likes to talk to young girls. The safety behaviour and attitude of the minority workers are very much influenced by their leader or peers of their own group which may be different than that of the local Chinese workers.

6. Can you give any recommendations for improving safety performance of the ethnic minority construction workers?

To do more training for the minority, and improve their own language skills like picking up English. To pick up Chinese may be difficult. Some of my boss English men learned their Chinese in about 20 or 30 year time, eventually when they retired they must say in Chinese. But in the first 5 year he couldn't understand what words the guys are saying about.

The minority workers should be informed at their safety induction training what are the channel of communication in case of safety matters. They should be urged to make use of the channel without any hesitation. Some of them should be designated as mentor to other compatriots so as to enhance their involvement in safety participation.

7. Do you have any information about accident cases of ethnic minority construction workers?

Last year in Water and Sewerage Department (WSD), the minority excavator who was the only worker in excavation was half buried because of soil collapse. Then the firemen arrived. The whole event from he was buried to he was rescued took half one hour, however eventually he passed away. Indications about the cases and incidents for the ethnic minority will be found from the labour department, and they are not only about the safety communication problems but also they don't understand instructions and the mistake with foremen. The Chinese and Pakistani may have different understanding about the signals when operating the machine. There is not separate accident statistics carried out for the ethnic minority.

8. What is the existing communication network structure?

Basically try to deal with themselves, that's the problem, because the guy is not in the site all the time and the guy may manage to gain people in different site. The problem is that if they found some problems there, they have to call the guy. But the guy may come back to the site on the next day, then the accident can happen in betray. That's why we would like to have someone who can improve in communication, and can tell the safety manager what's dangerous or use the hand signals to alert the main safety contractor guy. Some of young ones have complained the main contractor. The leader rips them off. Maybe the main contractor paid them 100 dollars, but the workers can only get about 60 dollars, as the leader rips them off. That's also another problem. When they gained less pay, of course we don't expect them work hard, as they will be paid by 100 dollars. The existing communication network is either through the leader of the minority workers or an interpreter who knows the language of the minority workers.

9. What could be an effective communication network structure?

All the ethnic workers on site are to be informed and ensure their understanding the effective communication channels for making enquiry regarding the method of works and reporting hazards on site. More diagrammatic instruction and more visits from voluntary organization for the minorities could be arranged.

10. Whether, good safety performance staff has an effective communication structure?

(This has been clarified by the research team that the inclusion of this question is cross checking whether the respondent knows what safety communication is about.) Good safety performance staff on site should be able to communicate to every worker on site effectively on safety issues.

11. What are the main communication tools (e.g. mobile phone, body language) and means (language) used by ethnic minority workers in construction sites?

We can improve the system by using more cooperation. I understand the XXX and XXX (construction companies) they are using that already (comics). But only in one minority language, not in all. Nowadays, the translation is not a difficult task, as we can put it into Google. Although sometimes it is useless to use Google translator, at least the key words can be translated. We can make some colour code and hand signals. Basically I will ask around all our sites, they answered the same. That’s sort of fear, because they don’t know the language to contact with the minority. It is their leader to do the translation.

(This has been clarified with the research team at the meeting on 30/4/2014 that the meaning of “main communication tools used by the ethnic minority workers” is referred as the communication tool between the minority workers and the Chinese workers.) Body language is the main communication tools used by the minority workers with the Chinese peers and foremen.

12. How frequently safety manager interacts directly with ethnic minority workers? Whether interpreters or translators are used for effective safety communication with ethnic minority workers?

(It has been clarified with the research team that safety officer is countered as safety manager.) It is depended on the actual situation on site and believes that the safety manager will interact the minority workers when necessary.

13. What modes (formal and informal) of safety communication are used for ethnic minority workers by the safety manager in construction site? Who will the ethnic minority workers seek help in case of safety problems?

Formal modes are the communication mode between minority workers and the safety officer/safety manager. From observation, minority worker who do not speak of the local language usually seek help either from another ethnic workers or from their team leader.

14. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?

To my understanding, most of the contractors employing minority workers are providing translated safety trainings to the minority workers eithers through a translator or through the leader who knows the minority workers' language.

15. What are the major safety communication problems of ethnic minority workers when communicating with local co-workers in construction sites?

Language barrier is the major safety communication problems of ethnic minority workers.

16. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

In order to remove the language barrier, ethnic minority workers are encouraged to lean the key safety terms in local language so that safety communication can be more smooth and direct.

17. What measures should be taken to improve safety communication of ethnic minority workers in construction site?

The contractor has a duty of care to the minority workers and they should ensure that minority workers fully understand all the safety instruction. Hence, all the minority workers should be encouraged to apprehend the key safety terms in the local language. Some contractors arrange big feasts serving with the traditional food of the minority workers so as to bridge over the cultural gap.

18. Remarks:

The public works we have a more stringent system than labour department. We have taken all these scores into account. One main item of this scorecard is belonging to safety. We can get very high or very poor accident frequency rate. The chief engineer of the main contractor will explain why this happened, what they are going to do and how to achieve the target of the accident rate. If they have fatal accident, they have to go to DEBB to attend a report interview, and the safety board will interview them. They have mutual trust between the Chinese and minority, and language barrier is one problem. The manager or supervisor need to get in the safety report scheme, and let the worker know that if they report the incidents, suggestions or promotions, they can get 100 dollars cue points. As for the green card scheme, the workers have to pay for the induction training. None of the safety managers or supervisors has been ripped off, and only the workers are ripped off. For the public works, we pay them based on a number of items, like the completion of safety plan, whether they employ a safety officer. For the public works, the only penalty we give them poor or very poor is based on their performance report. The induction training is supposed to be translated by the leaders or supervisors, but the leader is not always there. So it is encouraged to use the graphical mean or comics to tell the workers what to do. The majority of the safety officer spends only about one or two hours in the morning doing excises with the workers and goes back to the air conditioner room and does some paper works. They should go back to the construction site and not let the workers do things on their own. We have to pay 5% of the project cost on safety.

Interviewee I

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Site observation reveals that ethnic minority workers are usually employed as general workers for some unskilled or semi-skilled works in trades like steel bar bending, earthworks and metal scaffolding erection.

Under the specification clause PRE.B6.150.6 of Housing Authority new works contracts, Safety Plan should be implemented on sites to keep the sites in a safe and healthy working environment. Therefore, all workers working on sites are obliged to have similar safety performance. The Safety Officer should supervise and monitor the implementation of the Safety Plan and ensure that sub-contractors and all persons working on site are made aware of and comply with the Safety Plan.

2. What are the major safety and health problems faced by ethnic minority workers in construction sites?

Ethnic minority workers are working under the same working environment as the local workers. Therefore, with a good safety management system, no significant safety and health problems would be faced by ethnic minority workers only.

3. What are the current practices in management of safety of ethnic minority workers in construction sites?

Under current practice, all workers entering the site should carry a valid green card, i.e. a basic training for safety on construction sites. General or site specific induction training is also arranged for all new workers. Tool box talks are organized to workers once per week and are attended by workers who are engaged in activities relevant to the topic of that training. All workers who are new to construction industry are identified by a 'P' label on their helmets and are assigned a mentor at a ratio of 1 mentor to not more than 4 probationers under a caring programme for 3 months. All workers with relevant job experience but newly arriving at a site are identified by an 'N' label and provided with a safety orientation programme for 2 weeks. All these measures apply to all workers.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

Under the safety management system, there are no major differences in safety performance between local workers and ethnic minority construction workers.

5. Can you compare safety culture/climate of ethnic minority construction workers with that of local workers?

No such data is available.

6. Can you give any recommendations for improving safety performance for ethnic minority construction workers?

A good communication channel to promote safety message is good for all workers working on site. For these minority workers, because of their language barriers, maybe using some graphics and some videos in their mother language will be better. The safety instructions are usually in Chinese and English. Some contractor produces the posters in their mother language, but not many.

7. Do you have any information about accident cases of ethnic minority construction workers?

We don't have lots of accidents in our new works contract. In last year 2013, we have 55 cases existing in all kinds of services. Only very few are related to ethnic minority, and most to local workers. We all reported to the labour department. No particular observation is noted from the accident cases in the past.

8. What is the existing communication network structure? Do the ethnic minority workers communicate with the contractor's site supervisory staff and other local workers who may mostly be Chinese?

There are not many ethnic minority workers working in building sites. Most of them can speak Cantonese. As most of them are working in small groups, the ganger or someone who speaks local commonly used language can translate for them.

One example shows below is a clause in sub-contract of a building contractor Shui On. The sub-contract stated that workers employed by domestic sub-contractors must communicate in fluent Cantonese, Mandarin or English language. Otherwise, a full time translator should be deployed on site to assist for communication. Furthermore, a safety supervisor should be employed to translate and explain to those workers about safety information. The safety supervisor should speak Cantonese and read Chinese language.

In case the ganger is not at the spot, does the communication between the contractor's site supervisory staff and the ethnic minority workers break down?

For general communication, they can wait for the ganger. For emergency/unsafe situation, stop the work first.

9. What could be an effective communication network structure?

It would be helpful for the ethnic minority to learn some local commonly used language. HKCA can also consider publishing a glossary showing the interpretation of some common terms in ethnic minority language to facilitate the contractors to prepare the safety promotion materials in related languages. What else? Same as above, provide a full time translator or a safety supervisor that can speak both language for communication.

10. Whether, good safety performance staff has an effective communication structure?

A good working environment and good communication structure are both essential to improve construction safety. In what time are tool box talks arranged by the contractors for the workers? Is it included in the working hours or out of their working hours? To minimize the interruption of the works, usually tool box talks are arranged on the spot of the working area within the working hours e.g. 3:30 to 4:00 pm in small group. The tool box talk would be limited to about 15 minutes focusing on one hot topic, e.g., safe use of electric power, working at height, etc.

11. What are the main communication channel(s) used by ethnic minority workers in construction sites?

The ganger can speak their mother language and local language. This is the communication bridge. The morning briefing is in Cantonese for the local workers, and the ganger convey the messages to the ethnic minority workers. As for how the ethnic minority workers communicate with the local workers, I will find out that later. The main communication channels are tool box talk, pre-work exercise and safety meeting, general and specific induction training on site.

12. How frequently safety manager interacts directly with ethnic minority workers? Whether interpreters or translators are used for effective safety communication with ethnic minority workers?

Pre-work exercise and safety meeting is a daily activity on site to remind the workers for daily safety issues. Usually, the ganger would explain to ethnic minority workers the works on the work of the day, lead workers to identify the potential hazards of the work and make them aware of the degree of risks and measure of precaution.

13. What modes (formal and informal) of safety communication are used for ethnic minority workers by the safety manager in construction site? Who will the ethnic minority workers seek help in case of safety problems?

The ethnic minority workers may seek help from their ganger in case of safety problems.

14. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?

No, I don’t think so. Usually only in commonly used local language. Case of extra mile of poster in other language noted. See attached pdf file.

15. What are the major safety communication problems of ethnic minority workers in construction sites?

With the help of the ganger, the communication between the ethnic minority workers and local workers will be no problem. The ganger would explain the required information to the ethnic minority workers that he leads.

16. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

It would help if the ethnic minority workers can learn some commonly used local language.

17. What measures should be taken to improve safety communication of ethnic minority workers?

I think it’s also good for ethnic minority workers to learn commonly used language. They can give a booklet which is translated into the commonly used language and their mother language to the ethnic minority. If they take the handbook with them, it is easy for them to memorize. We require some resources, such as the glossary. To prepare graphics and videos with the mother language of the ethnic minority on site safety.

18. Remarks:

Nil. As for the communication structure, the interviewee will find out later.

Interviewee J

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

First of all let me clear about whom do you consider ethnic minority workers. (South Asians including Nepalese, Indians, Pakistani or Philippines, Westerns, South African). Because in our construction sites a lot of workers are working from different nationalities. We have imported around 180 miners from Philippine and also specialized skilled labour force from Australia, Britain and South Africa (front line supervisors). They are here for a couple of years to complete the project. Most of the workers are working in tunnelling projects with a very specialized skill. Some of the Nepalese are general labour, scaffolding, steel fixers, some are miners and side electrician also support staff such as ventilation engineer, plant engineer etc. Large group of imported work force from Philippines is working in tunnelling. We do have Nepalese (who are born and raised in Hong Kong). A large group Nepalese can either speak Cantonese and English.

There is a general perception about cultural issues such that the local workers are hesitant to work under the supervision of non-local supervisor. We deliberately mix different nationality workers into small teams which are working together and speaking a common language on a construction site to minimize the communication gap. The team leader is usually of the same nationality. All the imported labour is employed by XXX under the Supplementary Labour Scheme. XXX is providing them logging and we are looking after all of them. The Nepalese may be directly employed by XXX or they might be employed by the sub-contractors. The South African are also employed by XXX. Earlier they were employed by specialist sub-contractor from Australia.

Communication is a major factor affecting especially in tunnelling there is a lot of communication which is not face to face and usually done through radio which is more challenging. So the workers did not have personal communication. Other things include if anything gets wrong who will take charge of responsibilities that's why we put different teams together. There are cultural issues and one group think the other one should take lead and respond to the issues.

2. What are the major safety and health problems experienced by ethnic minority workers in construction sites?

Communication is considered the main problem. All of our communication in done either in English or in Chinese which could be a problem for non-local Chinese to understand. We do have some training sessions and safety posters in Nepalese. We deliberately employed Nepalese safety officers so they can lead their Nepalese community workers. All of these Nepalese safety officers are residents in Hong Kong. They were ex-military employees (also called Gurkhas) and they were given opportunity to work in the construction industry of Hong Kong. They are considered more disciplined and can manage risk in a better way because of their military background. Some of them are now promoted to safety officers positions. However the current generation is not as disciplined as the earlier one was.

3. What are the current practices in management of safety of ethnic minority workers in construction sites? (any different treatment for ethnic minority workers)

They are not treated differently. We are following our Standard Operating Procedures (SOPs). All of our training courses are mainly in two languages i.e. Cantonese and English. We also carried out supplementary training courses into Nepalese and English, if workers group are not very fluent in English. We do not want to risk the safety of any of our employees. When it comes to tunnelling, scaffolding, then we will run the courses into Nepalese to suite the ethnic minority needs and the training course is also carried out by the Nepalese Safety Officer.

In Singapore, there are more ethnic minority workers working in the construction industry as compare to Hong Kong. In the morning briefing we separate them into small group of same ethnic background workers and brief them into their own first language (five different languages). We also prepared safety posters in five different languages i.e. English, Malay, Mandarin (simplified Chinese), Tamil, Telugu, Thai, Bengali.

On the other hand, the morning briefing practice in Hong Kong is different from Singapore.

N.B: One thing we have observed that majority of the front-line workers (local and non-locals) will never say NO to any of the instructions given to them (whether they understood or not). They all will say YES to all the instructions given to them.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

Firstly signage, if they are not in their native language. There could also be cultural challenges in terms of working with a Ganger (leader) i.e. that leader is a local Chinese or foreigners. The big challenge was dealing with is that whether the workers understood the instructions given to them? We rarely heard people saying NO to any instructions.

5. Can you compare safety behaviour/attitude of ethnic minority construction workers with that of local workers?

A lot of interaction is encouraged by all the workers i.e. demonstrating PPE and we saw much higher participation from the non-local workers (NLWs) such as Nepalese and Indians as compare to local workers. The local workers are very reluctant to stand up for role playing as compare to NLW workers. The daily wages are same (local and NLWs) if they are directly employed by the XXX. There is no difference in payment. The NLWs specialist workers are paid more as they are very specialized in their skills and in high demand. Carpenters and steel fixers are in shortage and they are paid more than other trades. But may be after this construction boom will come to an end then their wages might get balanced with other trades i.e. electricians. Especially in our HKIA project we have to pay extra to these skilled workers. Because they have to go through all the immigration clearance (non-earning hours) and they worked extra time. The Nepalese workers are much disciplined and they follow the instructions given to them. But their behaviour has also been changed now a day. In training courses, the Chinese workers do not pay much attention to the safety instructions. However, the work ethics are very high for the local workers, they are very hard working. The workload is quite similar for both local and NLWs. There is a time limit to complete certain task, which they have to complete. This leads to extra risk taking behaviour. Sometime they take extra shortcuts to complete their job done. If there is a Nepalese supervisor, it would be very difficult for him to control the local workers. On one of our construction site 8/11/B, it took time for a Nepalese supervisor to get respect from local sub-contractor employees. In a new group, these issues will arise to adjust. To minimize the racial issues, we focus on increasing the interactions of front line workers.

6. Can you give any recommendations for improving safety performance of the ethnic minority construction workers?

The industry should make more provisions for the NLW, who cannot speak English and Chinese. CIC should run more safety training courses (green card trainings, silver card trainings and trade specific trainings etc.) into their native languages.

7. Do you have any information about accident cases of ethnic minority construction workers?

There are often claim by the Nepalese workers that they have more incidents claims than that of the local workers. The labour laws in Hong Kong are very favourable to the workers; they can claim 80% of compensation for the injuries for 2 years. It is often claimed that the claims are often being abused by the NLW workers. Our own study suggests that there is not any difference in compensation claims by the local and N. That is not being abused by the NLWs. In how much time a person will get recover is a very subjective. But it was observed that the Nepalese will come back later even if they get recovered because they are getting paid 80% for their wages.
We see more incident at the end of the project, may be because of time limitation for project completion. We follow the pay for safety scheme for public sector project and we are also encouraging the private sector to follow it. XXX also had similar scheme.

8. What is the existing communication network structure?

Both top- down and bottom-up. We have 6 business units. All of those 6 units follow basic safety management system. Then we have project related issues at project sites. All sites have their own communication structure. For the ethnic minority workers are grouped and if they want posters into their own languages that are arranged accordingly. We have tool box talks and lunch meetings. Tool box talks are carried out continuously bi-weekly. Such as we have 1500 workers on one site so we have to arrange it accordingly.

9. What could be an effective communication network structure?

The key is that the front-line workers can communication effectively with each other. That's why we have grouped them together.

10. Whether, good safety performance staff has an effective communication structure?

We do measure the performance of different teams at an area level (area management performance) but we did not look at the ethnic minority level.

11. What are the main communication tools (e.g. mobile phone, body language) and means (language) used by the ethnic minority workers in construction sites?

Usually face-to-face (daily briefing) communication is done and is supplemented with posters and visual aids. Our method statements are in Cantonese and in English. We are also using signs and symbols in our method statements. We encourage the workers to speak their local language and will not insist the NLWs to work with other groups but if they are working with other NLWs then we advise them to speak in English. For example if South African workers are working with British workers. So if SA workers are talking in African then we have to remind them to speak English while working with British workers.

12. How frequently safety manager interacts directly with ethnic minority workers? Whether interpreters or translators are used for effective safety communication with ethnic minority workers?

Safety manager is interacting with workers every day. Although I can't speak Cantonese but I can interact with local workers through gestures and will be accompanied by the local safety officer.

Morning talks and tool box talks are carried out in Cantonese and in English. Only Nepalese team will be briefed in their mother language. Philippines will be briefed into their native language.

13. What modes (formal and informal) of safety communication are used for ethnic minority workers by the safety manager in construction site? Who will the ethnic minority workers seek help in case of safety problems?

8/11/B has a large group of Nepalese workers, so we hired Nepalese site safety officer. In case of fire and emergency then it is very standard and all will be evacuated through safe ways. They will be evacuated and assembled into an assembly place.

14. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?

At the project level, the trainings are conducted in local language but not at organization level. Although we do have ability to conduct the trainings courses in Nepalese at our trainings centre. But there should be enough people to be trained. However, if XXX would also want then the contractors can arrange trainings for the NLWs in their native languages.

15. What are the major safety communication problems of ethnic minority workers when communicating with local co-workers in construction sites?

That is the challenge. In our tunnel project, we are trying different teams working together. There are pros and cons of mixing different nationalities together such as in the short run, there would be communication problems but in the long run, that would benefit to both workers and organization.

In the Channel Tunnel example, there were British and French workers were working together. One worker broke his leg, because of some misunderstanding and miscommunication.

16. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

Recognise the different nationalities and also measuring their language skills speaking and reading Cantonese, English. Getting the right work, intent and spirit is important for translating into different languages. Also measuring the proper understanding of the safety training material. Producing the material into different languages. There are translating companies but they might not understand the construction industry specific terms. We rarely used external translator for translating our safety material.

There is one translated company who is very expert for safety comics.

17. What measures should be taken to improve safety communication of ethnic minority workers in construction site?

Recognising the ethnic minority workforce and their language problems. In Singapore we have translated (safety comics) into various languages. But not in Hong Kong.

18. Remarks:

Interviewee K

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Most of the ethnic minority are working as a general labour. Nowadays they are more professional and started metal scaffolder, steel fixer. Gradually making improvement. Total 300-500 ethnic minority are working in this site and total of 900-1400 persons are working here. There are Nepalese, Philippines, Pakistani and a few Indians. Particularly what I experience metal scaffolder are Nepalese and they are skilled when compare to local workers. The foreman and ganger can communicate with the frontline workers. Other trades like steel fixer still have language problems. Mostly in these trades ganger or supervisor is local so they have communication problems. The level of education of these NLWs is also very low and communication is an issue.

2. What are the major safety and health problems experienced by ethnic minority workers in construction sites?

Mostly the level of understand and communication barrier. For example if a Nepalese worker just finished his secondary education and they came to Hong Kong and started working in the construction sector. The culture and level of understanding of NLW about local safety instructions is not very high.

3. What are the current practices in management of safety of ethnic minority workers in construction sites? (any different treatment for ethnic minority workers)

Not different practices. Earlier the induction trainings were only carried out in Cantonese but gradually it is getting better and now some of the induction trainings are also carried out in their respective languages. Currently there are only 13 Nepalese Safety Supervisors registered with Labour Department. The Hong Kong local new generation in Hong Kong is not willing to work in the construction sector so the number of NLWs is increasing. The induction trainings and tool box talks (not all companies) but major contractors are carrying out in the NLWs native language.

Pay for safety is also in practice in this project. There is no legal requirement that we need to hire translator or interpreter or safety supervisor from ethnic minority. But big companies like Gammon and Leighton have been practicing this but it is not compulsory. XXX is also gradually moving towards that direction. But as the ethnic minority workers in the construction sector are increasing there is a need to legislate this if possible. HK Housing Authority may have a contractual requirement or guidance but it is not a legal requirement.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

The first thing is understanding. If they do not have any understanding of the safety regulation and safety instructions then they might not comply with safety rules and regulations. For example, while working on height a worker must wear safety harness and belts. Although they are coming to work and taking the induction trainings and also attending tool box talks, but they do not fully understand that will affect their safety performance.

Local workers fully understand the safety requirements but they might also not fully comply. Because of their negligence and unsafe attitude they might not obey the safety instructions. The old people might not want to learn new and efficient techniques but they want to follow their own methods of doing work. However, the NLW may also neglect some of the safety instructions it is only possible to work safety through a safe working behaviour.

The understanding of the NLWs is less so that will affect their safety performance. Well it required time to make regulations so that ethnic minority safety trainings could be carried out in their native languages and posted translated into their native languages. I have already suggested HK Labour Department and CIC, at least if we have 20 workers from ethnic minority then the Safety Supervisor/Ganger should be appointed from their respective country, so that they can understand the safety instructions and he can work as a bridge between frontline workers and management.

Because I can speak local language, I do not have had any problem. The new worker may seek some information about me (my work attitude, strictness etc.) from others workers. What I normally do, firstly I introduce myself and also the rules and regulations and explain them the labour laws. If the workers will follow them they are happy to join our team if not then they can leave.

5. Can you compare safety behaviour/attitude of ethnic minority construction workers with that of local workers?

They have different attitude because locals are somehow can neglect safety instructions but NLWs. For example, if we are working on a particular location and I suddenly visit that place and they already know that I am coming then they will start putting everything in right order and they will try to show that they are doing very good job. The local workers will pretend to show that they are doing very good job.

But in reality they do not. On the other hand, the ethnic minority workers will not behave like this. They are obeying the safety rules and regulations. They will work what they know and will not showcase anything like local workers. If the NLWs are working at height, if they do not put safety harness either unintentionally or by mistake they will not bother. But if I notice, then I talked to them in a group meeting that this is not a right way. I will advise them the consequences of the unsafe behaviour.

6. Can you give any recommendations for improving safety performance of the ethnic minority construction workers?

Basically the training plan need to be revised and training materials should be translated into the ethnic minority languages. Most of the companies have training material in Cantonese. At least, they should change into English. As a Senior Safety Manger working in big construction companies for several years, I have helped those companies to translate some pamphlets and banners into Nepalese. Even XXX and XXX have set up safety training centres for capacity building of safety staff of ethnic minority and they have also translated safety training material into ethnic minority languages. They employed Nepalese Safety Officer for training, that Nepalese Safety Officer can speak Hindi which can be understood by the Nepalese, Pakistani and Indian front-line workers. That person can also speak good English which can cover other non-Chinese workers. So this is a good initiative from these contractors. I have also suggested these companies to translate safety policy and change safety plan to outreach the ethnic minority workers. Safety training plan by the main contractors need to be changed.

7. Do you have information about construction accident rate (per 1000 workers) especially of ethnic minority construction workers? (Any info. about safety performance of ethnic minorities as compare to local workers)?

In this construction site a couple of cases of injuries. One of them was a fake injury. Mostly Pakistani workers are involved with fake injuries and that can also be seen in other ethnic minority workers. For example, a worker can get hurt and he can go to the doctor and ask for 4 day sick leave and can get compensation. But in some case, the compensation is claimed for more than 2 years. It is a bad practice by some of the ethnic minority workers. Even Gammon and Leighton were very careful when employing these NLWs, knowing that there might be these kinds of fake cases and which is an extra financial burden on these companies. We have 3 cases in our site. We have full time site registered nurse. We are providing first aid treatment depending on the severity on the injuries. For XXX projects, there are designated free panel doctors and the workers are treated free of charge. They are providing quick service. Through this medical treatment by the XXX, we are trying to minimise the working hours lost due to sick leaves and provide quick rehabilitation so workers can come back to work. We are also receiving XXX Safety Incentive Scheme. There are some set targets, if contractor achieve those targets then the contractor will receive safety incentives and bonus payment. Pay for safety scheme is for housing projects.

Every month we have to report to XXX and if we will reduce the accident rate then we can claim incentive for that. We spend that money on our workers such as we arranged trainings, prepare banners, and provide cash coupons/prizes to top performing workers on monthly basis. We have list of requirements through which we select best performing best area manager, engineer and front-line workers etc. Before award distribution, the senior management meets and selects the best performing workers. In the morning briefing, the project manager will address and distribute the prizes.

We have divided the whole project site into different areas and an area construction manager is responsible for their own area. The construction manager is also responsible for his/her own area safety as well. This type of scheme can also be implemented such as divide into trade wise or floor wise or area/block wise.

8. What is the existing communication network structure (Organizational structure of Safety Department)?

Currently here are 2 projects i.e. 823 A and 823 B. 823 A is about TBM (Tunnel Boring Machines) and 823 B is about Cut and Cover Tunnel. I am Senior Safety Manager of the whole site---> one Senior Safety Officers for each contract ---> Safety Training Officers. So it is Top-Bottom communication. The Site Safety Officers are directly reportable to Senior Safety Manager and then they report to the area manager. Firstly they report the good things and then problems. If there would be any significant problem on construction site, the safety officer will ask to stop the work and will inform me. Safety officer will take pictures and prepare a report. I will contact the area manager and ask him to rectify the work and then start the work again.

In Hong Kong, because time is more precious and there are penalties for late completion of project work. Because of time limitation, this is considered the major reason affecting the safety of workers. There are technical difficulties as well. Although there are not much incentive for early completion but the contractor can save the additional labour cost. Currently there is not such labour shortage but there is high turnover in this industry. Workers will look for better opportunities. If workers will not comply with the safety instructions then we will cancel the entry permit of that worker so that he cannot work with us. But firstly we will give formal warning/written warning to the sub-contractor.

9. What could be an effective communication network structure?

Top-down approach is common. But bottom-up is also encouraged. We have suggestion box to listen to the complaints of workers. If that suggestion is very valuable then we will reward them. We also have scoring system for areas and we have Area Management Award for best safety performance. If there are incident, the area loss the points.

10. Whether, good safety performance staff has an effective communication structure?

Definitely if the workers have good communication their safety performance will also be good. Some of the safety professionals are putting blind eyes and will try to avoid reporting any problem. They are not helping neither the safety team neither the operational team. The staff should be pro-active in safety. Nobody is perfect so if there is problem that should be reported and the person should be cautioned. Guide the worker that it is not good for himself and for his family. He should be encouraged to ensure safety first then you can help others. Discuss with them that if you are only bread earner for your family. We put their family issue first and because you have to look after your family and kids back home and if something will happened to you, you lose everything. This way we tried to win their heart and mind.

11. What are the main communication tools (e.g. mobile phone, body language) and means (language) used by the ethnic minority workers in construction sites?

Nowadays some of them are fluent in Cantonese both Nepalese and Pakistanis and if they do not then they are communicating through the ganger. Normally the local and NLWs are communicating each other through foreman or ganger. They are also using body language. Usually if there are five sub-contractors are working on one area and all of them had only a few ethnic minority workers then we cannot separate them from the local workers. They had to work in a multi-disciplinary group. In certain degree we encouraged them to integrate with local workers so they can learn Cantonese and also share their culture. Otherwise they would be isolated.

Do you think there is racism issue?

Not that significantly but still there are some cases where the ethnic minority are feeling some racism. But comparing with other countries Hong Kong is still much better place to work.

Whether the ethnic minority workers are paid the same as of local workers?

It depends in which trade the ethnic minority working. For example, only very few carpenters from ethnic minority, mostly those are locals. The steel fixers who are skilled in bending are paid higher.

If the NLWs have silver card or trade specific card, will they be paid higher wages?

Yes, if they have trade specific trainings they will get paid higher wages. Such as a banksman who is able to communicate all languages. For example we have a crane here and the banksman is working as a signalling. He is getting extra payment.

12. How frequently safety manager interacts directly with ethnic minority workers? Whether interpreters or translators are used for effective safety communication with ethnic minority workers?

Because I can speak Cantonese, English, Nepalese and Hindi. Normally there is a need I arranged specific training or if there is a serious injury incident then I will arrange meeting in different groups and cautioned those workers for following safety measures and how this kind of injuries or accidents can be prevented. These are arranged as specific trainings. Sometime I gave instructions to sub-contractors to send those ethnic minority workers to attend basic trainings. I have also been invited by the OSHC and Labour Department to deliver safety trainings for the ethnic minority workers.

What time is selected for these types of trainings?

Normally before lunch time and we will also provide them lunch. The trainings are carried out during the working hours and will not be deducted from the payment.

13. What modes (formal and informal) of safety communication are used for ethnic minority workers by the safety manager in construction site? Who will the ethnic minority workers seek help in case of safety problems?

Actually the ethnic minority workers are very reserved and they do not talk about any problem. They think that if they will speak out, the manager and other workers might think that he does not know anything and they might feel humiliated. For example, if the worker is working without any safety harness or proper platform, the foreman or ganger might have push the workers to finish the work within a specific time. If the worker will not finish then he will be warned to be fired from the work. The workers need to follow the safety standards.

14. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?

Yes, we carried out ethnic minority language and also the instructions are also translated into Nepalese.

When I was working in Gammon. Yes, there were efforts to translate the safety signage and safety instructions into Nepalese because CEO and Safety Director of XXX were very positive on that issue. I also put efforts into this and we tried to help those ethnic minority. But I think there is not much effort and the momentum is slow down. Pictures speak itself and it does not need any language.

15. What are the major safety communication problems of ethnic minority workers when communicating with local co-workers in construction sites?

Understanding the safety instructions is considered**.**

16. What measures should be taken to improve safety communication of ethnic minority workers in construction site?

The main contractors need to revise their training manuals and training plans. If possible they should translate into the safety instructions into their native languages, if not then at least translate into English. But there resources issue which is very important. When I was working in XXX, we have translated safety instructions on PowerPoint slides into 3 languages i.e. English, Cantonese and Nepalese. Although Cantonese and English are official languages in Hong Kong but mostly the sub-contractors are using only Cantonese.

Whether the sub-contractors also required to recruit safety officer?

Well if the sub-contractor sum is up to a certain amount then they are required to recruit a safety officer. For example, if the contract sum is over HKD100million and workforce is more than 100 persons.

Whether that safety officer is reportable to you (Senior Safety Manger)?

He is responsible to report to the project director and then will cc to me. We cannot rely on his report. We are having our own safety inspection and safety audits.

17. Any Further Remarks:

Interviewee L

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Currently, the NLWs can also speak very good Cantonese. Tunnel workers, piling work (but usually related to cement grouting work). Others are when the supervisors are English speaking then they will employ Nepalese and Pakistani front-line workers. If the supervisor is Cantonese speaking, then they will prefer Nepalese. For the tunnelling projects, we usually employ Nepalese worker because they are more expert in this field. They can also speak English.

Any effects to their safety performance?

For me, it is similar. But sometime safety performance for certain ethnic minority is good and sometime is bad. But it is not because they are ethnic minority but because of their supervisor/foreman. We have Nepalese working for our sub-contractor and also working for our tunnelling team. Those workers for our tunnel team are good and that working for sub-contractor is bad. Not because of their nationality but because of the sub-contractor. Because the workers will always follows the instruction of their supervisor. Workers do not want to hurt themselves because of the unsafe work. Some of them may take some risks while working on site.

How many workers are working at your site?

Approximately we have 50-70 ethnic minority workers are working in our tunnel projects. We have majority Nepalese and then Pakistani workers. When the workers have green card they can work in construction site of Hong Kong. The only thing is worried whether they can speak English. If they can speak English, they can pass the simple written test and if they cannot pass the written test we will not employ them.

After getting green card, do they need to pass a written test?

Yes, we have induction training test and the workers have to pass that test. Unless if you are a supervisor and you have your own team and the whole team is not fluent in English but you can translate into English and communicate between front-line workers and management that is fine. During the work, we do not allow any work without any communication. We have a labour supplier who will provide ganger and front-line workers. Mostly the workers are working in groups of same nationality.

2. What are the major safety and health problems experienced by ethnic minority workers in construction sites?

3. What are the current practices in management of safety of ethnic minority

workers in construction sites? (Any different treatment for ethnic minority workers)

We have similar approach for managing both local and non-local workers. We do not target to them based on their nationality. For this project we have employed a Nepalese safety supervisor. We asked that supervisor to translate some of the important things such as safety policy, method statements, procedures, housekeeping safety rules to let them understand. Because we are not sure how much they understood.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

The only difficulty is their understanding about safety rules and regulations. Because we do not know if they really understand the safety procedures. Even if they do not understand but they still can say that they fully understood. Mostly we are giving instructions in Cantonese and English. But because we employed a safety supervisor so he can communicate with Nepalese and Pakistani workers. If we still find some difficulties then we will look for ganger/leader, because some gangers are very good in English, Cantonese and Nepalese to translate into their common spoken language i.e. Hindi or Nepalese. We need to make sure that they understood the message.

5. Can you compare safety behaviour/attitude of ethnic minority construction workers with that of local workers?

Sometime the Nepalese are better. Especially, the Nepalese will really follow the rules but sometime local workers will neglect the safety instructions. The locals will follow the instruction when you will monitor them if you will not monitor them they will do it in their own way.

Whether that will affect their safety performance? I mean whether the safety performance of NLWs is better than local workers?

I think yes. If you will correct them once they will follow the instructions and try doing the work correctly. Because for many workers when they will come to new working site. They will have to pass the trade test.

6. Can you give any recommendations for improving safety performance of the ethnic minority construction workers?

We tried to translate the safety instructions as much as possible into their own languages. That's why we employed a Nepalese supervisor. Some of the safety rules are translated into their own language. The ganger is very key person who is usually fluent in Cantonese and English so he is communicating the message to the front-line workers.

7. Do you have information about construction accident rate (per 1000 workers) especially of ethnic minority construction workers? (Any info. about safety performance of ethnic minorities as compare to local workers)?

According to XXX, in a rough estimate they employed around 5% ethnic minority work force. They contribute 50% of the reportable accidents. For this project (XXX), we have 138 reportable accidents cases, during September 2012- June 2014. The ethnic minorities are around 10% of the workforce but the number of accidents cases are more than 10%. Most of these injuries are slip (finger injuries), lighting (manual handling) laps of attention. There was one fake case was reported because it was a Sunday 25 August, 2013, no one was working on that day. But he reported that he came to work and get hurt his back. There are some groups of people who know the legal requirement of Hong Kong and they might have exploited the compensation system. But because they are very few in numbers if someone exploit this compensation system and they are highlighted more. For Chinese, there might also bad persons but there are only 5 locals are bad those will not get more attention. But, if there are only 5 Nepalese are working, if one is misusing the compensation.

8. What is the existing communication network structure (Organizational structure of Safety Department)?

We have Project Manager/Project Director--->Project HSEQ Manager--->Project Safety Manager----> Safety Training Officer---->3 Safety Officers--->4 Safety Supervisor----->2 Site Nurses---->1 Clerk.

Whom the ganger is reporting?

Engineer/Foreman----> Ganger (Leader) --->Frontline workers. The workers are not directly reportable to the safety team, instead they are reporting to the construction manager. The safety team is directly reportable to project director. In case something happen, we go to project director. But in normal cases we can talk to the workers directly.

9. What could be an effective communication network structure?

Actually, we have weekly meeting to discuss everything. When I say we are reporting to each other. One of the convenient ways of the meeting, we both discusses issues.

Did you divide your construction project into different area?

Yes, we have area management plan. Area management is very common in Hong Kong construction industry. For example one safety officer is dedicated to one area and he is directly communicating with construction team.

Did you observe different safety performance in different areas?

Yes, because different sub-contractors are working in different areas and also the area is also different. We have different safety requirements in different areas. For example when are working adjacent to the road work next to the public, demarcation of separation of pedestrian is very important and the safety requirements will be different as compare to the main construction site.

How about the workers' performance? Whether the safety performance of different areas is also different?

Yes, will be different. For example in one area there might be different supervisors.

Are you comparing safety performance?

Yes we compare the safety performance and the safety performance is also different in different areas.

Is there any incentive or penalties for different areas?

Yes, because this is a XXX project. So we are receiving 'Safety and Environmental Incentive Payment Scheme' similar to 'the Pay for Safety Scheme". This amount is around 1.5% of project sum. We award that incentive to the workers and sub-contractors as well.

10. Whether good safety performance staff has an effective communication structure?

Yes, must be.

11. What are the main communication tools (e.g. mobile phone, body language) and means (language) used by the ethnic minority workers in construction sites?

Face-to-face meetings, mobile phone using WhatsApp or We Chat etc. English and Chinese are the main medium of communication.

12. How frequently safety manager interacts directly with ethnic minority workers? Whether interpreters or translators are used for effective safety communication with ethnic minority workers?

At least once or twice a week visiting the construction site. No translator is used.

How you are communicating with front-line workers?

Sometime they can understand simple English. Actually they understood what the problem is? Even they cannot understand 100%, I can say why? Let say if I ask about housekeeping.

Whether the housekeeping of ethnic minority workers is better than local workers?

Well, it is subject to the sub-contractor and supervisor. If the supervisor (local or non-local) is not paying any attention to the safety then the safety performance of front-line workers will be poor. So I do not think there is much difference.

How about the salary?

I think it is subject to the trade and relevant work experience. For example ganger and banksman, they are all expensive in Hong Kong. Similarly welder is also paid more than other trades. But if there is a sub-contract arrangement, then we do not know how much they are getting. The sub-contractor or labour supplier may has his own profit margin, they are getting much more payment from the main contractor. But might be the front-line workers are not get paid that much. For example, XXX directly employed NLWs Nepalese workers, because it is French company and they speak English. All the workers are well paid. The welder may be earning around HKD 50000 per month.

13. What modes (formal and informal) of safety communication are used for ethnic minority workers by the safety manager in construction site? Who will the ethnic minority workers seek help in case of safety problems?

Both formal and informal. Formal includes, full induction trainings. Informal may include tool box talks and pre-work briefing talks and during the inspection we talk to them face-to-face.

For the ethnic minority workers induction trainings are conducted in English or their local language?

If one labour supplier brings Nepalese workers and they cannot speak English, then the supplier may also bring a translator. We also have special arrangement for NLWs if they are not good in English. Our training officer may fail the NLW if he cannot communicate and pass the test. We ask him to come again in another day so we made a special arrangement for him through a translator or ganger.

If the NLW faced any problem, then whom they seek help, if the ganger is not around?

Not that worse. Even the ganger is not around then they might ask the other local or NLWs. Some of the workers Cantonese is very good.

14. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?

Induction trainings are still conducted in Chinese and English. Later we will look for

Nepalese supervisor to conduct trainings in Nepalese. At the moment, only Chinese and English.

Do you have any separate trade testing facility at your site, where the new workers can demonstrate their trade specific skills?

According to the contractual requirements, we need 25% of our people should have craftsmen qualifications (Trade Test Certificates) http://www.hkcic.org/eng/skilltest/bc-trades01.aspx?langType=1033

For Hong Kong Government's projects, the legal requirement is 50% of workforce should have craftsmen qualification. But for our project we have only 25%. We are meeting the minimum contractual requirements such as for bamboo or metal scaffolder etc.

15. What are the major safety communication problems of ethnic minority workers when communicating with local co-workers in construction sites?

Actually they are working group by group such as Chinese and Nepalese groups. In case if they need to communicate within group then they will communicate through ganger (who is fluent in Cantonese). For sub-contractor, they do not have any translator but they rely on ganger.

How many sub-contractors are working on this construction site?

Major 3 sub-contractors (they have Nepalese workers) i.e. 1st is Tunnelling, 2nd is XXX and 3rd one is local company (local company is doing grouting work), but they also have sub-sub-contractors.

16. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

As I mentioned earlier, translation for the NLWs. Training material and media should be carried out in their own language. For example, I can understand English training but I may not absorb the 100% content of safety instructions. The safety instructions in their own language are very important which might also affect their safety behaviour.

17. What measures should be taken to improve safety communication of ethnic minority workers in construction site?

Ethnic minority worker such as Nepalese/Pakistani safety officer may be employed (as part of management team), who may help in translating the material in their native language. Currently we are relying on Labour Supply Company, who is supplying general labour, ganger.

Do you think communication is a big problem?

No, I do not think so. But how we can improve the communication is very important. For safety, the hardware (construction machinery) has not changed but the software (safety attitude/behaviour) of workers needs to change. If you want to change the attitude then it is better to use their native language so that they can understand the safety instructions and follow them. For example, if you are watching a movie. You may listen or but will also look at the sub-title. If the sub-title will be in your mother language you will read sub-title.

18. Any Further Remarks:

Interviewee M

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

In my experience, they mainly join labour intensive trade, such as steel fixer. Sometime we hire we hire Nepalese supervisors so they can translate the safety instructions to front-line workers. So they can work as a bridge between management and front-line workers. Currently the OSHC is also trying to translate the safety information into EM languages. They are also making videos as well with sub-title in EM languages. There are two types of communication is carried out i.e. verbal communication or through media such as video, pictograms sub-titled into EM languages. For the verbal communication a ganger is commonly used who will be tri-lingual (can speak 3 languages Cantonese, English and Nepalese). We have a quality engineer who is tri-lingual. We are only delivering raw materials on site such as providing concrete. We seldom involved with construction activities. We can find much more Nepalese steel fixer, because this work is harsh for the Chinese and local people, and they cannot do this kind of difficult job. Most of them are general labour, bar bender & steel fixer.

There is no difference and no effect of a particular trade on the safety performance of EMWs. As long as they are working in construction site, which is a risky sector as compare to other trades.

For this type of business, do your workers really need to care about safety and health?

Yes, we also need to follow the OSHC. Our safety people are focusing on our safety plant.

Are you carrying out Safety Audit?

No we do not carry out our safety audit after 6 months. But we are not bound to submit a safety report to the Labour Department. We have different legal requirements for safety audit report submission.

The communication of ethnic minority has improved recently. But earlier around 10 years ago nobody cares about their communication problems. Even it was also noted that all the training material was provided in Chinese language and after the trainings the EMWs were just to fill up the training record. All the training material and media was in Chinese. But currently some big contractors are carrying out trainings in EM languages and they have also hired EM safety supervisors.

2. What are the major safety and health problems experienced by ethnic minority workers in construction sites?

I think there are communication problems and the basic awareness and knowledge about safety by EM. May be their country of origin may not have very high safety and health standards compared to Hong Kong or even the basic safety knowledge.

But all of them have to attend Mandatory Basic Safety Training Courses (Green Card)?

Yes, but the training is very fundamental and only for a day. Sometimes the safety performance may depend on the behaviour and if they are not accustomed to do it safely even if they knew it but they fails to follow it accordingly that may be relevantly dangerous.

Is this safety attitude/behaviour problem applicable to ethnic minority or to locals as well?

Safety attitude and behaviour is applicable to both local and EM. But the point is that the problem existed in Nepalese and minority is much more serious than local workers. Because the local workers have more experience and been educated better than Nepalese. In HK I think the higher percentage of minority workers is from Nepal, and Pakistan.

3. What are the current practices in management of safety of ethnic minority workers in construction sites? (any different treatment for ethnic minority workers)

There is no different treatment. They are treated similarly as local workers. I think the practice is that we arrange tri-lingual and bi-lingual supervisor to communicate with this kind of workers and translate all the training and safety materials into their own language.

If the workers (local and EM) will not obey the safety instructions then they might be punished with some penalties which is a common practice in the construction industry. If the workers will not follow the safety instructions and not listening to the supervisor then those will be warned.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

The difficulties are the communication and their awareness about safety. The other issue is their different risk perspectives. For example, for the management perspective the safety compliance should be to a certain level but for the workers is looking in their own perspective. Worker may think, he did not get injured by doing his job in his own way for the last many years and I did not get injured. One purpose of the safety training is narrow the gap between the workers own risk perspective and the management.

5. Can you compare safety behaviour/attitude of ethnic minority construction workers with that of local workers?

I think the safety behaviour of minority is much more obedient than the local workers, as long as they are buying your idea, or they accept your will. However, the local workers have their own characters, sometimes they are more likely to behave on their own way.

Whether this different attitude will affect the safety performance of EMWs?

Yes, I agree; that the EMWs are more obedient and it will affect the safety performance. But for the local workers, even if they know the consequence of unsafe behaviour, they might ignore sometime. They might take short cuts. We have a Nepalese supervisor for EMWs. Every worker should have safety supervisors in HK, no matter which country they are coming from.

6. Can you give any recommendations for improving safety performance of the ethnic minority construction workers?

They need more training and more communication, and the training materials need to be translated into their own language. I think training is very important for the Nepalese workers in their own languages. Furthermore, the Nepalese workers are required to work they haven't tried before or with no previous experience.

7. Do you have any information about accident cases of ethnic minority construction workers?

I can quote a very serious incident about ten years ago, a very hard-working Nepalese worker started to work at 7:45a.m. On the day of accident, actually, he started working 15 minutes earlier than normal working time (8:00am is normal working time). He did not attend the morning briefing rather he started working as usual. He was working on the edge of the bridge. He did not use safety belt while working on the height. He accidently fell down more than 20 meters and passed away. The second reason of this accident was that he tried to do the work in his own way without following the instructions of supervisor. The non-local workers do their work in their own way which is normal practice in their country, but may be that is unsafe in HK. So training is very important which will improve the skill of workers and let them know the correct working procedures.

8. What is the existing communication network structure?

Most of our communication is top-down. The senior management design and develop all the safety instructions and safety manuals and then passed down the frontline workers. We have junior staff working under the safety supervisors and have senior officers. I will visit the construction site once a year because we are just delivering the construction materials. We are hardly involved in any construction activity. But I can say I quite often visiting the production plant.

How frequently you are visiting your production plant?

About once every two week. It's only for me. Almost every day our safety officer will visit the plant to have inspection. I am also responsible for health, safety, quality and environment.

9. What could be an effective communication network structure?

I think an effective communication network structure needs to be two ways. Usually top-down is quite easy and straight forward, but bottom-up required more time and effort is needed to figure out how to manage it through proper mechanism. Because we need to gather the information from the front-line workers, foremen and middle men. Which is not very easy to manage. In our company we do not have successful bottom-up communication structure. We just have a very simple channel for the front-line workers to express their opinions. May be through the monthly HSE meetings, some representative may highlight the problems of front-line workers but there are not so many constructive ideas presented. May be they are too shy or some other reasons. We also have channel for near-miss reporting card similar to the suggestion box. We welcome front-line workers to express their views about how to improve the safety through the near-miss reporting card and suggestion box. We already have this kind of channel, such as open mobile phone number of safety supervisor and suggestion box, but it's still passive. It has not been used pro-actively. We should have more effective way to talk with minority through regular meetings or lunch box/hour. In my last company, we have such kind arrangement. Just as a platform for an open conversation with front-line workers. We do it continuously and sometime it seems very time consuming. Because you need proper planning and coordination with safety staff and front-line workers to hold this kind of meeting. Currently it is difficult for us to arrange such regular meetings which require more time and resources as well.

10. Whether, good safety performance staff has an effective communication structure?

Yes, sure. It is necessary because I think safety is very much relied on good communication.

11. What are the main communication tools (e.g. mobile phone, body language) and means (language) used by the ethnic minority workers in construction sites?

In my experience, I don't know Nepalese language, and I will use my body language when communicating. Besides, it's useful to use pictures to let the minority know what the consequences are in case of they are not doing safely. The safety supervisors can translate the messages into in ethnic minority native languages.

12. How frequently safety manager interacts directly with ethnic minority workers? Whether interpreters or translators are used for effective safety communication with ethnic minority workers?

In our company, it's an issue because all staff can speak English. So in our company the communication is ok. However in the construction site, it can be a problem and it's often essential for safety manager to communicate with ethnic minority workers.

13. What modes (formal and informal) of safety communication are used for ethnic minority workers by the safety manager in construction site? Who will the ethnic minority workers seek help in case of safety problems?

Both verbal and non-verbal are used. I think the first guy they will seek help is their supervisor or ganger/leader. They seldom go to a safety supervisor. That's why we have to rely on safety supervisor on safety issues. The most ideal case is he should be tri-lingual but it's impossible to find a safety supervisor who can speak two or more ethnic minority native languages. So we set a supervisor who can speak both Nepalese and English for the Nepalese workers, and set an Indian supervisor for the Indian workers, etc.

14. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?

The safety trainings should be conducted in ethnic minority native languages. I support this arrangement. Even in the occupational safety and health council (OSHC) in HK, they are doing such arrangements already. They are so many trainings and materials are translated into Nepalese and Pakistani languages.

15. What are the major safety communication problems of ethnic minority workers when communicating with local co-workers in construction sites?

The language is the main problem. The other problem is that the ethnic minority workers always keep silent even if they don't understand. They are pretended to understand sometimes. This is the problem. The problem of the local workers is that they don't care the trainings or the minority workers. I think it's not necessary to cooperate with each other.

16. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

I think the trilingual supervisor, translators, trainings, training materials and safety rules are the key success factors of effective safety communication of ethnic minority workers in construction sites. The media can play an important role such as training videos can be shot in English or in their own languages. Even they don't understand what they are talking about in the video; they can guess the meaning through the animation.

17. What measures should be taken to improve safety communication of ethnic minority workers in construction site?

18. Remarks:

Interviewee N

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Most ethnic minority workers join the trades including bar bender and scaffolding (bamboo and metal types). There are around 30 projects in our company; average workforce in daily is about 8000 workers while ~1% of total workers are ethnic minorities. Their role is a general labour but not skilled labour, as an assistant and delivers materials to work together with other skilled labours. In site practice, we will form a group and appoint one person be a supervisor/ ganger who is able to understand Cantonese. Then, we will pass the training materials to the supervisor to conduct the related trainings within the group.

We have about 30 or something projects. Among those projects we are employing around 8000 workers in construction site. So as we know the total number of the ethnic minority is about 80 to 100, which means about 1% or 1.2% of total construction workers. Major trades they are involved in are bar bender, not too much in metal scaffolding. Steel fixers are not skilled labour, and they are only general labour working in erection and delivering material.

Any effects to their safety performance?

In our company we didn't come across such problems that they have some safety issues or safety difficulties. Even for those who can talk directly in Cantonese, they can speak well or at least can understand. So they have no major effects on their safety performance. Besides, on the other sites we have some communication with the Construction Trade Union. They have also set-up some mechanism for those ethnic minorities if they want to have some assistance. They can approach us or approach our HRO. And then we can have some connections with the Construction Trade Union. In the current OSHC Cantonese speaking competition for the construction workers (South Asian), means those non-local or non-Chinese, our team win the first price, which means they can speak and listen Cantonese quite well. Staff from different departments such as site engineering team, security team and other front-line workers participated in this event. They set up small groups and performed in the OSHC event.

2. What are the major safety and health problems experienced by ethnic minority workers in construction sites?

The major problem is that their awareness of safety and health issues still needs room for improvement and enhancement. I think we feel their knowledge on safety and health, even they know safety awareness, and sometimes there is still room for improvement.

Q: How do you know if they really understood the safety instructions or not?

Our arrangement is that for each group or each gang of minority we will appoint one of them to be either safety supervisor or safety coordinator. This guy must speak fluent Cantonese or can understand we instruct. By this appointment, he got the responsibility to deliver all the safety and health messages, instructions, information, etc. We will pass to him maybe in English or by verbal, what are the training content. He will talk to his gang or his team.

Who will make sure that they have really understood the safety and health message?

We have got penalty system for every non-compliance, we observed, we will mark down and issue the warning letter. In our general observation, we seldom found any non-compliance from these ethnic minorities. Among our reportable accidents, in the last year we have about 120 reported accidents, with the accident rate is 15.5. Almost none or may be one or two of such accidents are from ethnic minority.

Q: Does it mean that the safety performance of ethnic minority is much better than the local worker?

I am not sure. In other word, by safety measurement they did not report any safety and health problems.

Q: Is there any perception like if they report their problems to the senior management they will lose their job?

No. personally, I feel they are quite strong to protect themselves or protect their right. If they have any problem, maybe injured or they think they should have holidays and annual leave etc., they will be fight. In my experience, I think they will not afraid if accident is reported, they will be laid off.

Q: Apart from penalty system, is there any reward system if they perform well?

Yes, we got the recognition or award system to a group or two groups or individual sub-contractor, but not to the particular person.

3. What are the current practices in management of safety of ethnic minority workers in construction sites? (any different treatment for ethnic minority workers)

There are about 20 ethnic minority workers employed as a direct labour (daily-paid) by our company. In practice, we have a penalty system to monitor their safety performance at work. Moreover, a recognition system has implemented to reward subcontractor with good safety performance. Actually, we treat ethnic minority workers as same as the local workers. For instance, by custom Nepalese have some festivals celebration annually and request for rest day. We will approve such request and with respect of their custom.

I think more or less similar treatment. Personally, I feel their behaviour or their practice is almost similar is similar as what we are. For example they can speak Cantonese, and they know horse riding. We don't find they have a very special behaviour that we need to have to a particular arrangement for managing them. Except for some of the Nepalese, they will request holiday/rest for their special festive day. On that day all or most of them will request holiday. But they are working on daily wages, if they will come to work they will get paid if not then they will not earn anything.

Q: From these 80 to 100 ethnic minority workers, do you know their nationalities?

We don't have such data. The rotation or the turnover from the sub-contractor that must also depend on sub-contractor ganger. So we only know maybe 20 or something directly employed by our company.

Q: What about those who request for special festival leave and the one who are not directly employed by your company, the sub-contractor they belong to allow them leave?

Because those are mostly day labour, if they come, they will be paid, and if they don't come, they will not get paid.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

In practice, we will provide instructions to ethnic minority workers in English, through appointed supervisor/ ganger for translation of safety rules and regulations or get the signage and safety information in Nepali from OSHC. However, it is difficult to understand their perception of safety rules and regulations as they are strong to protect themselves. The main difficulty could be if they really understood the safety rules and regulations.

Q: Are the safety rules and regulation which were given to them both in Cantonese and English?

Yes. We will give them English rules or regulations.

Q: Are the main difficulties their understanding of what the safety staff sent to them?

Yes. The staff from the sub-contractor. Some understand English, and some don't understand. For those who will not understand, we will rely on the verbal communication by the appointed ganger.

Q: Is there any translation into their own language, such as Nepalese/Urdu, about safety signage or safety instructions?

Those are mostly done by the OSHC. When necessary, we will contact a translator who can read and write English, Cantonese and Nepalese, not too much only one or two translator can do so.

Q: They are especially appointed?

When necessary.

Q: How about the ganger? Can they speak Cantonese and Nepalese as well?

For the gangers, yes they can.

5. Can you compare safety behaviour/attitude of ethnic minority construction workers with that of local workers?

In qualitative measurement, it is difficult to make comparison while no obvious difference between local and ethnic minority workers in quantitative measurement. Personally, I think ethnic minorities are a bit more reactive, a bit silent and seldom to complain. I think it is quite difficult to quantify. But in qualitative, I think there not much difference.

Q: How about if they could not understand the safety instructions, will they report to the ganger or just say everything is OK?

I think they are not very pro-active such that if they don't fully understand the safety instructions given to them, they may not say so. They will keep silence and re-active and follow what they could. They seldom complain.

6. Can you give any recommendations for improving safety performance of the ethnic minority construction workers?

We are still relying on communication channels through the appointed supervisor/ ganger. The appointed supervisor/ ganger is required to attend safety course for obtaining related safety knowledge. But the improvement is still need to be quantified. I think the communication. Also we think the appointment of the safety coordinator of ethnic minority is very important. And he can acts as a bridge between the local workers or safety guy with the ethnic minority team. If the appointed safety coordinator could receive safety supervisor training and get basic knowledge about safety. This could help.

Q: Is this a better solution to improve their safety communication?

I think it is essential. Whether they could improve or not! Still cannot be quantified.

7. Do you have any information about accident cases of ethnic minority construction workers?

There were 120 no. of accident cases reported last year and the accident rate per 1000 workers was 15.5. In our company, we would like to treat all workers fair, and don't want to hide any injury so no administration charge for accident reporting. Three reportable accidents (not serious injury) related to ethnic minority workers happened in the past 2 years, including suffered back pain while sitting too much and twist the legs while walking along the site or staircase. No related reportable accidents occurred recently. For the local workers, the accidents happened usually due to manual handling and fall from low height level.

In my memory, we reckon maybe two or three cases. This is quite strange. One security guy complain that he is sitting too much and he got back pain because of sitting too much. Another person twisted his ankle.

Many years ago before I joined this company, I know there was a serious case. The worker lost a leg. But I don't get the details, because this was happened before I joined this company. All the cases I mentioned are all from minority.

Q: Is there recent cases from the ethnic minority?

Both of them are from ethnic minority. I think we don't have cases of ethnic minority in recent years. Recently a local worker fell down from low level and the second is manual handling. The total number of the cases is 120 in the past year (accident rate per 1000 workers is 15.5). We have a different practice from general practice. We do not have any administration charge for any reportable accidents. We will have penalty system for those who will not report any incident or near miss, because our boss don't want hide any injuries. We want to treat the worker fairly.

8. What is the existing communication network structure?

In general, for site level, site management committee meeting, site committee meeting, trainings (e.g. toolbox talk training, a target for a worker is to receive 8 times training per month) and notice board. For management level, there will have sectional safety meeting, management committee meeting, quarterly housekeeping inspection, accident panel (The injured person admit to hospital for 9 days or more) to explain, discuss and investigate the cause of accident, and weekly meeting with project managers and etc. Recently, a near miss case of tilting of crawler crane happened in a project recently, a 6 weeks task audit has conducted for seeking continual improvement in site safety. Currently there are many communication levels. At the site level, start from safety management committee, site safety committee, weekly meetings, daily meetings, morning gathering/briefing, and joint interactions, tool box talks, displaying rules and procedures on site etc. I think most of them are commonly used in HK.

Q: What is the current hierarchy of the safety department?

You mean at the head office level. Apart from the meetings of safety management committee which is chaired by the general manager, we also have different areas safety meeting and also we have second tier audit for the safety. We also have quarterly housekeeping inspection. We have accident panel. We monitor individual sub-contractor or sub-sub-tier. If there is any serious accident. Our definition of serious accident is if a worker hospitalised for 9 days or more or disabled up to a certain level. We will call the sub-contractor to report and explain the case to the safety management team. During the Monday meeting for this team, in case of what particular occurrence or special accident, that will be explained the causes of the accident using the PowerPoint to bring to the safety management team, general manager and other project directors. So we share the information and will prevent the re-occurrence of similar accident.

Q: Are you also getting the record for the near miss cases?

For the near miss cases, yes, we do record. For example, almost two months ago we have collapse of a crane. Nobody was injured. The general manager personally visited the site. We have also discussed in this in our Monday meeting. We also set up team to prepare an improvement plan. Then consecutive six weeks we did the follow up for the major causes of incident. A risk assessment was also carried out to look at the overall project risks and then we identify six items or six topics that we need to control. Each week we will audit and inspect one of the topics. For example, this week is we have lifting operation, next week working at height and in next week, we will focus on another topic.

Q: How many safety staff is working under the senior safety manager?

For HK, at site level, we have around 60 safety staff on site. Each team, we will have the team safety manager. Then on top of that I am working as a Deputy Safety Manager. I have supporting team, from the central there are seven safety officers. In total, we have about approximately eighty safety staff.

Q: Do you have training safety officer?

We don't have particular post for safety training officer. At our training centre, every day we will provide safety induction about special training topic that adapted by rotation by our safety staff. Maybe this guy from the site, half of them will go to the training centre next time the other team. We have our own training centre in. For individual staff we will have pre-work safety meeting. Each individual will be assessed. Then we will prepare safety methods and training programme. They will have tool box talk. They will have specified safety training. Our target for safety training is that each worker in each month should attend tool box talk. In fact, what we have trained recently is about four to six points. We have yet to cover all the major aspects of safety trainings.

Q: About the safety performance, you have divided into different area/groups to look at the safety performance of each team.

Yes, for safety performance management, we will use quantitative qualitative, success management and failure management. For the most common and easy to measure safety management is by number of accidents. We will also encourage our team to participate in external safety promotions safety management system etc. We also reflect the performance by the safety management audit. That is carried out every six months. We are also monitoring the housekeeping.

Q: Are you obliged to have the DNV safety audit?

DNV the total optional programme, we don't apply on our site. We think it is not so easy to our building projects as compare to other sectors. We have an agreement with the insurance company to compare our performance by using ISAS. We know where we are, we can compare with other sectors.

Q: What is Independent Safety Audit Scheme (ISAS)?

ISAS was adapted by the Works Bureau in 1995 and a pilot scheme was run in 1996. Up till now, they are still using this from version 1.0 to 1.4. Subsequently, there are improvements. They are using this to measure the performance of approved contractors particularly for the housing projects. For Works Bureau they are using this as a tool to measure their capability of contractors. For in what field they are using this, there are two measurements. The publicity of contractor is for in case of ---the contractor to get ---, they will get the tunnel and -- whether they need to receive the ISAS or the safety auditor. ----even for the Labour Department.

Q: How frequently this Audit is carried out?

The ISAS is carried out every six months.

9. What could be an effective communication network structure?

An effective communication network structure could be measured in qualitative, quantitative, successive and failure measurement. In successive measurement, safety competition and safety audit are commonly used as a tool for measurement. In failure measurement, accident cases and its analysis are commonly used.

I think the existing communication arrangement is acceptable. But main area for improvement is safety attitude and safety culture of middle management and front-line workers.

Q: Is there any safety officer from ethnic minority?

No. I know in HK there is only one safety officer from ethnic minority. I cannot remember his name, but he is Nepalese.

10. Whether, good safety performance staff has an effective communication structure?

Personally, I think lack of communication would influence to the safety performance. In order to have a good safety performance, an effective communication structure is very important. If there will be clear communication, there will be not be many problems. Take the incident I just mentioned before for example, the crane was incurred because of insufficient communication from the administration, engineering and safety teams.

Q: About those ethnic minority cases? Were all of them genuine or fake cases?

I think once I get a sick certificate from a registered doctor, we could not do anything but we need to consult with insurance company. I think the existing compensation system we cannot reject any sickness certificate.

Q: Do you have any appointed nurse or doctor in the construction site?

No

Q: Are the workers insured?

For all the workers, they entered into our project, they need to attend the generic safety induction. At that time, they need to produce their green card, their skilled labour card, their CWRA (Construction Workers Registration Authority) card. If their sub-tier contractor appoints the worker an access card, they need to approve to us that they get insurance. We also have another umbrella insurance at the top.

Q: Is CWRA compulsory?

That is compulsory under the Construction Workers Registration Authority.

Q: How long this was made compulsory?

Around five or six years ago.

11. What are the main communication tools (e.g. mobile phone, body language) and means (language) used by the ethnic minority workers in construction sites?

The main communication tool is Cantonese and English, and through the appointed supervisor/ ganger as a translator.

12. How frequently safety manager interacts directly with ethnic minority workers? Whether interpreters or translators are used for effective safety communication with ethnic minority workers?

We treat ethnic minority workers as same as the local workers. At site inspection, I will talk to ethnic minority workers without translators as many of them were born in Hong Kong and can speak Cantonese fluently.

We do not treat them as special group, so the communication falls into our common practise. That is how frequently we communicate with local workers that are how frequently we are communicating with ethnic minority workers. We have similar system.

Q: If you talk with them in Cantonese or English, can they understand?

Yes, when I go to the construction site, I talked directly to the workers, and they can respond me directly.

Q: Do you need any interpreter or translator when you communicate with ethnic minority?

No.

Q: How about the ganger? Do you communicate directly with the ganger?

Yes, I directly communicate with the front-line workers.

13. What modes (formal and informal) of safety communication are used for ethnic minority workers by the safety manager in construction site? Who will the ethnic minority workers seek help in case of safety problems?

Meetings and trainings are the common channel for communication with ethnic minorities.

However, they must talk to their supervisor/ ganger when they want to seek help in case of safety issues but seldom to seek help from safety personnel.

Both formal and informal communication is used. Such as during safety inspection, morning briefing, tool box talk, etc.

Q: If they got any problem, do they talk to ganger or somebody else?

If they got problem, 99.99% they will directly talk to their direct ganger. They seldom talk to the safety officer.

Q: How about their working habit? Are they working in ethnic minority group or in mixed group?

They are working within mixed group.

Q: When they are working in mixed group, the appointed ganger is from EM or local?

As I mentioned, most of the ethnic minority are not team leader. They are playing a role of assistant, so two or three of them maybe assistant for four or five steel leaders. So they cannot work independently. For some particular trade, such as steel fixer, they may two deliver the raw material, so they will work mixed together.

Q: Are most of the foremen local worker?

Yes.

14. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?

Site induction training has Chinese, English and Nepali version. The appointed supervisor/ ganger will carry out the weekly toolbox talk training together with safety officer for the ethnic minority group. As we sent a direct employee to attend the safety course from OSHC in the past, he can help us to translate the training materials into Nepali. Also, we obtained training materials from OSHC directly. All we can do in either in Chinese, English or ethnic minority native language. We got one guy who can translate into Nepalese, or we can get free materials from the OSHC.

Q: Have you ever conducted the training into Nepalese language?

I remember we have one guy who attended the Nepalese training. But the OSHC is not quite often to provide such courses, because they just provide one or two a year.

Q: The one who attended this training was directly employed by your company?

We contact them, we pay and then they will go to attend.

Q: Does he directly employ by you or sub-contractor?

Yes, he was directly employed by our company. Because of the shortage of the labour supply in the construction industry, we even try to employ more Nepalese or South Asian manpower. We are trying to recruit more but response is not good.

Q: What do you think these imported labour (ethnic minority) can fill the gap or contribute to the shortage of labour supply?

My understanding is, the major shortage in the construction sector is not the general labour. We are looking for is skilled carpenters and steel scaffolders. Because many of them are becoming elder and elder. Maybe they are over fifty or something, or approaching sixty, so we are looking for young skilled labour. I don't think the labour of ethnic minority can fill this gap because they are not very specialised skills they are only general labour.

15. What are the major safety communication problems of ethnic minority workers when communicating with local co-workers in construction sites?

As the ethnic minority workers usually work with local skilled labour (in the group of 2 ethnic minorities with 3 skilled labour), the major problem is communication problem. Some ethnic minority workers may not understand Cantonese. Language is a major problem.

16. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

Through the translation of appointed supervisor/ ganger who is able to speak and understand Cantonese and English for those ethnic minority workers who only speak their mother language. Use more photos, drawings and videos during trainings and meetings to enhance their understanding.

17. What measures should be taken to improve safety communication of ethnic minority workers in construction site?

To encourage those ethnic minority workers who only speck their mother language to learn Cantonese and English. They should learn Cantonese or they should improve their English skills. Safety trainings should be conducted in their own local languages.

18. Remarks:

Interviewee O

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Most of them are working in comparatively high risk tasks, such as confined space, tunnel work and any other hard manual work. Because the local construction companies will most likely transfer the high risk tasks to the contractors. And these contractors transfer that job to sub-sub-sub-contractor and at the end EMWs will have to do that kind of job. For new workers there will be two type of safety helmet are labelled with N and P. N is for new worker in the construction industry and P represents new on the construction site. This is also applied to EMWs.

Q: Even they are not specialised skills?

They will be trained before they take the tasks. Basically the green card is a compulsory requirement and also the trade specific card is compulsory for performing the job.

Q: Any effects to their safety performance?

I am not sure.

Q: And when they are working in the confined space or tunnelling? The communication may be a problem? The communication may affect their safety performance?

We don’t have such data or any company did not report to use whether their safety performances is not good when compared with local workers.

2. What are the major safety and health problems experienced by ethnic minority workers in construction sites?

That is the communication! Because most of them cannot speak Cantonese, and their English is also not good or not able to communicate with their supervisor. Their supervisor may be not very well in English. Some of them can speak Cantonese very well, especially for those who have stayed in HK for more than seven years. This South Asian Cantonese Competition was a new programme launched by the OSHC. Normally for the ethnic minority, we arranged seminar. We go to several construction sites and arranged talks. Sometimes we have translator to match with the HK policy, because the ethnic minority is one of the important workforce. We talked with the safety manager or safety officer to understand how we can improve the safety awareness of workers.

Basically the ones who are living here, and the one who participated in that event most of them can speak Cantonese, so for them this was not a big problem. Some of them have lived here for less than seven years may not good. I remember that a lady from XXX. She now can speak fluently Cantonese but when we have conducted briefing. When she arrived in HK, we asked her how to tackle the language barrier. We have invited the construction company to encourage the Nepalese, but not be very much accepted, because may be Sunday.

3. What are the current practices in management of safety of ethnic minority workers in construction sites? (any different treatment for ethnic minority workers)

The supervisor will pick one of them (maybe a group of 3 or 4) who can speak Cantonese well in the construction site to help for communicating. The ganger or leader passes on the messages to others frontline workers and works as a bridge between workers and management. This is a normal practice in Hong Kong.

Any different treatment for ethnic minority workers?

No, there is no different treatment for ethnic minority workers.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

Communication and cultural differences and some of the workers are performing risky jobs and they need more safety trainings.

5. Can you compare safety behaviour/attitude of ethnic minority construction workers with that of local workers?

I think the ethnic workers are more concern about losing their job as compare to locals. The current shortage of labour force will also affect the safety behaviour of workers. If they will be laid off by one company because of their bad behaviour they might find a job opportunity in another company.

Q: Are the ethnic minority more obedient and they followed the safety instructions?

I don’t have such information about this topic. So I cannot draw such conclusion. In construction site, many construction workers don’t follow safety instructions, even for the local workers. Most of them will try to short cut for finishing their work without strictly following the safety procedures. It is very difficult to draw such conclusion that their behaviour is different from that of local workers.

Q: How about the safety performance of the ethnic minorities? Is the safety performance of ethnic minority generally better than the local workers?

The safety performance depends on how the construction site trained them and enforced the safety rules. Sometime the safety manager will not allow the frontline workers to join such promotional activities. The management might be afraid that the workers may meet each other and build some relationship and try to influence the companies for better site condition and salaries etc.

6. Can you give any recommendations for improving safety performance of the ethnic minority construction workers?

I think the training is very important. The training means more safety and health seminars and safety kit available in their local languages.

7. Do you have any information about accident cases of ethnic minority construction workers?

We don’t have such information about the accidents cases. Maybe for the accidents, you can ask the Labour Department. The construction site will report the accidents to the Labour Department. You can approach the manager in construction site. I am sure they have such information. This is difficult to get from OSHC. Maybe you can write a letter to ask for data. If you want to get the RMMA data, we also don’t have such data, you may consult about how to get such data. Of course I know the detail of the data is very useful for your research, but it is different to get such details.

Q: Are the accidents data about the public works or the overall construction which they talking about?

Overall construction, not about the public works.

Q: Do you know where we can get such data?

We don’t have such data, and our data also comes from the Labour Department, because as a government department they keep record of such data. All the HK industries report their accidents to them. OSHC is only doing the promotion and education and the Labour Dept. will enforce safety and health. We are also collaborating with CIC for arranging promotional activities and cases by cases our collaboration is varied. Labour Dept. CIC and OSHC have collaborated for translating safety material. OSHC cannot force the contractors to use signage into the EM language. If the companies have budget then they will arrange such promotional safety. The companies who have a large workforce of EM, they will put more effort and resources for taking care of EM safety communication needs including displaying safety signage into the EM languages and arranging toll box talk and morning briefing in their local languages.

8. What is the existing communication network structure?

They will use one leader who can speak Cantonese and pass the safety messages to others workers.

9. What could be an effective communication network structure?

From my understanding, the leader will give five to ten minutes briefing to ethnic minority. The morning talks are similar, but morning talk is general for all workers.

10. Whether, good safety performance staff has an effective communication structure?

I think the EMWs are not treated differently.

11. What are the main communication tools (e.g. mobile phone, body language) and means (language) used by the ethnic minority workers in construction sites?

They will use local language to communicate with each other. I think they don't have tools to communicate with each other. These questions are for safety manager.

12. How frequently safety manager interacts directly with ethnic minority workers? Whether interpreters or translators are used for effective safety communication with ethnic minority workers?

13. What modes (formal and informal) of safety communication are used for ethnic minority workers by the safety manager in construction site? Who will the ethnic minority workers seek help in case of safety problems?

14. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?

15. What are the major safety communication problems of ethnic minority workers when communicating with local co-workers in construction sites?

Language is a major communication problem. But local workers, they might understand the safety instructions but they may not follow the instructions.

16. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

The existing leader/ganger is very common and successful method to manage the EMWs.

17. What measures should be taken to improve safety communication of ethnic minority workers in construction site?

Recognising the ethnic minority workforce and their language problems. In Singapore, they have translated (safety comics) into various languages. But not very common in

Hong Kong.

18. Remarks:

This year we will have another theme. We are working on a movie or comics for safety. In the coming year we are planning for training kit for construction safety security and also for catering industry. It will include causes of accidents and how to prevent etc. We are also planning to use 3 different languages including Chinese, English and Nepalese etc. The training kit will include a booklet and also video. We are looking for interpreters and translators who can help us translate the material into different EM languages. We will use sub-title video. The video will be animated.

Interviewee P

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Some notices for different nationality workers, and some facilities for workers, lunch, some shower areas and some rest areas.

Q: Do you know how many non-local workers working in your whole company?

Below 50. We have some contractors who have Nepalese safety officer. Because there are one hundred Nepalese workers, we employ Nepalese safety supervisor or safety officers who can help us to communicate with the Nepalese workers. Because we are working very dangerously, maybe the workers will fall from the roof. Some contactors have employed Nepalese safety officers. Today we have only fifty Nepalese workers because the company is worried about the accidents caused by Nepalese workers. Sometimes they will bring the lawyer and their friends to the site. But the local workers are afraid to lose their jobs so they seldom do so. Because of the language barrier, it's difficult to translate to supervisor or ganger, so sometimes we may mistrust or misunderstand their needs. We have employed the Nepalese safety supervisor to communicate with them. It's required by the government that if the workers are more than 100, a safety supervisor need to be employed. There are some workers working under the subcontractor or sub-subcontractor as steel fixer. We have employed Nepalese safety supervisor to brief workers safety information every day. We have guarantee from the government that 1/5.

2. What is the existing communication network structure?

Top to down.

3. What could be an effective communication network structure?

We have budget for promotion 2,000 per month, for individual we have coupon for foreman and workers. For the housing project we have the same procedure that pay for the foreman and workers. For my company we have funding for safety promotion.

4. Whether, good safety performance staff has an effective communication structure?

For the safety performance, we have morning briefing and update safety information every morning. So they have good safety performance in this communication structure.

5. What are the main communication tools (e.g. mobile phone, body language) and means (language) used by the ethnic minority workers in construction sites?

For safety personnel or subcontractor, they work in group. Once there are some problems we have to choose the WhatsApp, which is more effective than walkie talkie. Someone don't carry walkie talkie anywhere, but they take the mobile phone everywhere such as at lunch and dinner, and they can get the message. In addition, WhatsApp can get a picture. We use mainly Chinese in our group, for efficiently we paste the English for the soften for some English understanding

6. How frequently safety manager interacts directly with ethnic minority workers? Whether interpreters or translators are used for effective safety communication with ethnic minority workers?

It's better to have translator. We have Nepalese and other ethnic minority workers. If it is available to translate, it is better.

Seldom, because we only directly interact with ethnic minority workers when there are some problems.

Q: For the safety supervisor, can he speak Cantonese as well?

Some, because only their parents are born in Hong Kong, they can speak Cantonese. Nearly half of young Nepalese workers can speak Cantonese.

7. What modes (formal and informal) of safety communication are used for ethnic minority workers by the safety manager in construction site? Who will the ethnic minority workers seek help in case of safety problems?

Formal communications are just for the morning briefing or talking with ganger and worker, but no meeting for ethnic minorities. We have toolbox talk and training translated into English not in native language. Only over half Nepalese workers and some other ethnic minority workers can understand English. They know English better than Cantonese. It is better to translate them into English than Cantonese for nowadays ethnic minority workers. The one they will find is ganger. Ganger is the most important for the working group and ethnic minority workers.

Q: For this ganger, is he working as a safety ganger or also as a foreman?

He is also working as a foreman. He also needs to do some construction work, and safety is his part time job and extra duty.

Q: How many front line workers are working under this person?

Under twenty. If they are more than twenty, they will be in another group. We have Nepalese ganger for Nepalese workers, and we have local ganger for local workers. We seldom have mixed group, because there will be some language barriers.

8. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?

The safety training are only conducted in English, not in EM language. Maybe in the future, we can get funding from the government for this training. There are some Nepalese officer who can help us to translate the safety materials into EM languages.

Q: There are some translations from the OSHC. Do you know about this?

I only know about they are not for the safety training, toolbox talk. We just get banner, some for the safety method.

9. What measures should be taken to improve safety communication of ethnic minority workers in construction site?

For the company, we need to try my best to translate the training materials to their EM native languages. This is priority. And the next is we need to employ Nepalese ganger to monitor the Nepalese workers. This is our target if our company employ more than 100 Nepalese workers, we will consider to hire a Nepalese safety officer for the good communication of workers.

Q: How about the safety training?

We have lots of paper work, working at height. We have some models better than paper. Maybe some PPT or model workers using the safety belt and the uniform.

10. Remarks:

Interviewee Q

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Probably a few of them are working for some trades, they are the front-line workers and employed by sub-contractors.

Q: Do they have some specialised skills?

For the last six months, we have employed some Nepalese workers for the erection of force work.

Q: Any effect to their safety performance?

They follow our instructions, and we are regularly doing tool box talks. We have also pre-work meeting to explain what they are going to do. Some of them do not follow our instructions and they are trying to do the work by their own way. Well as a management we do our inspection and warn them to not take any extra risk and use safety harness.

Q: Which language is used in these tool box talks, morning briefing, pre-working briefing?

They will be in English, because we don't have any such speakers speaking Nepalese. So we will conduct in English. And we will ask question first whether they understood the instructions in English or Nepalese. If they can only understand either of them then we will conduct this language. So they can understand.

Q: What about if some people cannot speak neither English nor Chinese?

We will identify those people who can't speak these languages and then explain them in their language. For our knowledge, most of them can understand English or Cantonese. The difficulty maybe whether they can express them into Cantonese, but many workers can speak the language.

Q: Is the ganger or the team leader also the one communicate with the ethnic workers?

We have foremen, and we have gang leader, so the ganger/leader most of the time can speak either one of the language (tri-lingual). If the workers have anything they don't understand, the ganger will do the translation. We don't know whether the translation is correct translation, and the workers really understood we can't tell because we don't know their language.

2. What are the major safety and health problems experienced by ethnic minority workers in construction sites?

I think this question is very broad. In terms of safety, it depends on what trade they are working in, subject to working in, height (there are always risk of falling objects from height), or hurting their hands while manual handling, constitutions, falling stones in the tunnel hitting some workers (I think there are more than one case in the past). O our site, when they work for us, they are subject to fall from height. That’s why we ask them to pay their full attention to the safety instructions and we will make sure that they anchor the point when working at height. Of course anchoring is the last resort. We have briefing before erection of formwork such that they all are standing on a safe place. Our front-line supervisors warn and instruct them the danger of working at height and making sure that they have anchored to a life line. The similar safety instructions also applied to the dismantling of the falsework (Falsework is a temporary structure used to support a permanent structure while the latter is not self-supporting). Total or partial collapse of a falsework may lead to serious accidents.

3. What are the current practices in management of safety of ethnic minority workers in construction sites? (any different treatment for ethnic minority workers)

I don’t think they are different. We don’t have different programme for the ethnic minority workers. We just follow the same programme. I don’t see any different programmes for different nationalities.

Similar safety instructions are for both local and non-local workers. But when they are not being supervised both will try to do the work according to their own way but when they will be supervised they will perform better. This also depends on the safety standard set by the project team. If the safety standards are high there will be higher outcome. It is very much depend on management and the project team. How seriously the safety is considered by the higher management.

Q: What would you do, if they might not understood the safety rules and instructions?

We did expel some works (not subject to nationality), who do not follow the safety instructions and continuously violate the safety rules. We will suspend them such that they realise that they are not allow to work unsafely. At the very beginning, we warn the sub-contractors. More supervision of the workers is ensured to comply with safety regulations. Nearly at all our sites we have penalty system to the sub-contractors for violation of safety regulations. The money collected from the penalty is used for safety promotion. We encourage workers by paying them some coupon for park n shop or superstore so that can really benefit for their wellbeing. We incentivise them for safety promotion rather only penalising them.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

I don't think they have any specific problem in complying with safety. It is all subject to the project management team standard set for the job or the level of acceptable. I mean everyone have different gauge to monitor safety, the stringent or more rigid the management in prioritising the safety. The worker will just follow.

5. Can you compare safety behaviour/attitude of ethnic minority construction workers with that of local workers?

I will say they are almost the same, and there is no difference that they are human being. The human factor is always kick in if you don't have proper system in place, they will just follow the rules that they are allowed. So I will say there are no difference between local and non-local. If you will not monitor them they all will behave similarly.

Q: Are there any differences of safety performance between ethnic minority workers and local workers?

No, there is no difference.

Q: How about in this kind of situation when there is a shortage o construction workers?

This is the problems with basic HK. Today the industry in HK is promising and booming. They do not necessarily need to follow your instructions. So they have choice to go to other project where the safety requirements are not very stringent. Many of the ethnic minority workers may not sub-let the work into small pieces. EM are mostly working on daily wages. They cannot share the profit Compare with the others local workers, they can get the share from the sub-contractor price for a certain amount of work. There is also a pressure on delivery then they take more risk. They are not paid by the unit. They are paid on daily basis and the number of the hours they worked. For the local workers, the experienced workers are paid by the unitary piece of work as compare to hourly basis.

Q: For the unity work, they will work as much as they can?

Yes, if we pay 100 dollar a day for example, we can pay per 0.9 cents per square metre. Normally you can only do 11 square metres, then you will earn ten dollars. If you can do twelve square metres or fourteen square metres, then you will earn more. That is the way how it makes a difference. If the workers have to do the works in unit, they have to take care of their own safety they might take extra risk. But if you are on daily wages then the workers will have enough time to do their jobs. Having said that it also depends on how they are being supervised.

6. Can you give any recommendations for improving safety performance of the ethnic minority construction workers?

I said we don’t have a lots of ethnic minority workers on site, so we don’t have special recommendations for them. We have documents for safety. I mean we have to do safety plan, we have to do lots of safety notices and publications in both Chinese and English language. But we don’t publish any safety notices in their language for the minority workers, because our organization doesn’t have many EMWs.

Q: Do you have any idea about how many are your direct workers?

A: For the direct workers. We have around fifty workers in one of my projects, and another fifty on another site. Altogether we have about 250 direct workers working for me and they are all Chinese Hong Kong local workers. For those ethnic minority workers, they are mostly sub-contractor workers, because they need to process different skills. For my workers, they are mainly manual labours for general construction works by training or breaking of concrete. These workers are all local workers, because the ganger or foreman is in charge of the Chinese background and he just hires the local workers. If we can manage to identify a ganger in charge of ethnic minority workers, at that moment all my workers will be ethnic minority workers.

Q: How about if those sub-sub-contractors are not following the safety rules and regulations. Labour Department will panelise the main contractor or sub-contractor?

The Labour Department only sue the main contractor. The law start to sue the sub-contractor but they never been implemented. There is only one case where the worker was sued. In my thirty years for work experience, there was only one case against the worker in last year. Many times it is against the main contractor, no matter how rigid or how many their safety plans you have implemented, or how well the measures are taken. If there is a problem, the problem always gets back to the main contractor. It may be true in many year back (possibly 40 year before) that the main contractor did not pay much attention on workers. Since 90s, I think most of the main contractors in Hong Kong have paid a lot of attention to safety. Gradually the safety system has been improved but still the all the responsibilities lies at the shoulder of the main-contractor.

Q: But on the other hand, pay for safety (PfS) scheme is only employed by the main contractor?

I don't think anyone enjoy the pay for safety. I think the idea was good. But I think the rule of the tender has fall the contractor and sub-contractor. This scheme is only used to leverage the bidding price. Some of the organization use the money for the safety, and for other contractors they will use to leverage to lower the price.

For us, we don't have budget to be used for safety, which means we do safety when needed and required, not only by —the law but also by the virtue of the worker.

7. Do you have any information about accident cases of ethnic minority construction workers?

No, because we don't treat them as different people, and we treat them as different for accident.

8. What is the existing communication network structure?

It is top down. Although we invite our workers to join our safety meeting, we don't have a lot of feedback from them. Because they are also keep on changing their working position every day. Directly employed workers will always follow the safety instructions because they know if they do not follow the instructions they may lose their jobs.

9. What could be an effective communication network structure?

10. Whether, good safety performance staff has an effective communication structure?

In our company, we have monthly safety meeting with sub-contractors workers. Besides that we have weekly safety briefing in that we brief our foremen, engineers as well as the managers about what safety requirement are for the coming week, because our working positions changes day by day. So on weekly basis we exchange information. So we need to change information of what safety we are requiring. We have morning exercise. During the morning exercise, we tell them what the activities there will be going on the day and remind the workers that they are getting near uncertain area. Reminding them of uncertain risks. When I visit site, I will ask questions in both languages to make sure people could understand.

Q: Is most used means of communication face to face?

Mostly face to face, and we also have notice boards, and morning briefing. We have large scale banners on site. We remind workers what are safety requirements. We will make sure that there are enough warning signs and warning notices displayed in both English and Chinese languages.

11. What are the main communication tools (e.g. mobile phone, body language) and means (language) used by the ethnic minority workers in construction sites?

12. How frequently safety manager interacts directly with ethnic minority workers? Whether interpreters or translators are used for effective safety communication with ethnic minority workers?

Safety managers are on site, compared to earlier when there was only one safety manager for an organization. Most of our jobs have safety managers. For the divisional safety manager, we have 2 on site to make sure everything comply with the safety requirements. We also have safety audits to check our safety compliance. Besides that we have also introduced another system which is called Fresh Pair of Eyes. Where after every two weeks a director and a group of seniors such as front-line foremen will visit the construction site on a randomly basis. Each of them they have their own check list. Then they will start to note down what are the deficiencies. Working at height, lifting, safety management system etc. all sort of safety related matters are inspected. The in-charge of the project is briefed on the findings and there is a scoring system. If the scores will be less than 50 marks then the project in-charge or some of his delegates will have to do 50 hours of safety service.

Q: Whether this team will only look at the overall performance of the project, or the safety?

They only look at the safety. For every two weeks, two groups of people from different levels led by one to two directors visit at least two of our sites.

Q: When did you start this?

I think we started this system six or eight months ago.

Q: Where did you get such idea?

This system is working very effectively. This system is still very new. So people still follow the rules seriously. So far I haven't heard anyone being punished to do safety service, which means all our sites has passed the scores. Obviously less performed sites will be notified. That is the good thing of this system of Fresh Pairs of Eyes. They will open their eyes and the middle management and front-line management will listen because it is from the corporate level.

Q: Do you compare the performance of different sites?

We don't compare this. It is still the performance of each project. Each project is unique in its nature and so for we are not comparing the performance but just use the scoring system.

13. What modes (formal and informal) of safety communication are used for ethnic minority workers by the safety manager in construction site? Who will the ethnic minority workers seek help in case of safety problems?

You can say both formal and informal communication is used. Because in the briefing session, in the tool box talk is the formal event where you have to sign a piece of paper what have been told and what they have been trained. So I think most of the time formal trainings and formal instructions. Informal communication will only be used when someone ask or some supervisor walk by and noticed that workers are not working safely. Sometime we will stop them, bring them down and tell them the risk associated with the work. This will be quite informal. Ad hoc stoppage on the site, because it happened at the spot, and the workers are not asked to sign the paper.

Formal Communication:

1. Weekly: PM Safety Walk
2. Biweekly: Fresh Pair of Eyes
3. Every 2 months: Chairman Safety Walk
4. Quarterly: Director Safety Walk
5. Anytime: Surprise Safety Check

Informal Communication:

1. Breakfast sharing
2. Site lunches gathering

14. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?

In our site supervisor, we don't have such training for ethnic minority.

15. What are the major safety communication problems of ethnic minority workers when communicating with local co-workers in construction sites?

Basically, it could be the language, or it could be the sense of belongings. Unless they feel they are part of this community and belonged to Hong Kong, many times they may behave differently. If they don't feel like HK home, they might not follow the safety rules. So I think the local language and the sense of feeling at home are very important.

16. What are the key success factors of effective safety communication of ethnic

minority workers in construction sites?

I think treat them equally and try not to avoid to speak the local language. Otherwise, you need even pay more attention in order to build their confidence here, and then their safety will performed better. I say that because I did it during some of my morning briefing on some sites. After I gave briefing in Cantonese I did asked if they understood, if they want me to speak in another language, some people raise their hands. From their eyes, I can see the level of appreciation, but this is very important, because they feel they are taken care of.

17. What measures should be taken to improve safety communication of ethnic minority workers in construction site?

I think we have already covered this in earlier question. Treat them well, openly communicate with them.

Q: Should the training be conducted in their own language or in Cantonese or English?

The training should be conducted in the language the workers can understand. I think in some of the training centres, such as CIC, CITB, sometime they arranged safety trainings in Nepalese language. We do have Nepalese safety supervisor, we do have articles in Nepalese language. Even many years back, I used to work in Poland, so we have four languages on notices also for Thai workers, Thai language. Currently, for the 10 major infrastructure project, we have mostly Hong Kong local workers, few from Nepal, Pakistan, Indians and Bangladeshi. Most of the workers from Nepal, Pakistan, and Indian can understand us very well. They probably could not be able to read our local language. But I think most of them can read English. I think most of them are bilingual or trilingual people.

18. Remarks:

Interviewee R

1. In what construction trades do most ethnic minority workers join? Any effects to their safety performance?

Most of these workers are in general labour. Some of them have become more experienced and have become supervisors. It all depends on the contractors, how many EMWs are working with them. The more EMWs they have then they are working in more trades. For example, we have a contractor who had 75% Nepalese workforce, they also have Nepalese supervisor. They will have all sorts of trades i.e. welders, riggers, scaffolders etc. Besides general labour we often see them in scaffolding trade. That is what I observed in my sites. In both of our construction sites (XXX).

Are they specialized in this (scaffolding) trade?

Yes. They are specialised in this trade. Usually now a day I can see, the whole team of Nepalese workers, the supervisor will also be Nepalese. The whole team will be of one nationality and working together in erection of scaffolding. Now group work is quite common in the Hong Kong construction industry.

How about tunnelling?

It depends, in what trades you are referring to. For tunnelling, usually you may refer to. It also depends on the master of that process. If that master of that process is specialised in English, likely we can see some Nepalese workers. But if the master is local and they will be more inclined to work with Chinese speaking workers. It also depends on whether the company have how many non-local workers. We have two contractors and very often they have this type of workers.

Do you know how many EMWs are working on your sites?

No, we do not have such information. Because all of them are treated as local Hong Kong people. We won't treat them differently. As long as they have a green card and eligible to work in Hong Kong.

How about your contractors have any imported workers under Supplementary Labour Scheme (SLS)?

I am looking after two projects, i.e., XXX and XXX. We don't have any imported workers. Because it was not permitted for these projects. For XXX project, there are contractors who have few imported workforce.

Any effects to their safety performance?

The Hong Kong construction industry is severely lacking the skilled workforce. We understand that we can avoid employing the EMWs. Although, the XXX is not their director employer, we ensure the promotion of safety and health of all workers including the EMWs. For the promotion items, we prepare we look into these type of problems. We can't leave those workers behind. We understood their communication problems. Even though our contractor is making sure that the workers can speak English. May be some of them can only speak Yes or No only. We understand that there are some workers who are only fluent in their native languages.

As a client we have also printed different pamphlets into Urdu, Nepalese and Pilipino languages. We know this is a genuine problem in Hong Kong. We have translated these safety pamphlets but we are no sure if the translation is correct or not. We know that there are communication problems.

2. What are the major safety and health problems experienced by ethnic minority workers in construction sites?

We treat all the workers equally no matter what languages they are speaking. But the problem is whether the safety information is understood by the respective workers. I have great doubt. Most of the safety people from middle level to senior management are Chinese or English speak foreigners. Only very few of EMWs are safety supervisors/officers, they are seldom reached to a senior position. How well those workers understand English is also. Especially the safety trainers very likely they are local Chinese and their level of English also vary. So a person speaking not very good English communicating with a person not understanding English very well. There must be difficulties in communication.

Are the safety instructions in Chinese and English only?

Well, the contractors who had large number of EMWs would consider translating safety information into different languages. In Hong Kong, we have only a few Nepalese safety officers and only one and two companies can hire those workers. Those companies have sufficient number of Nepalese workers that's why they employed Nepalese safety supervisor/officer. Usually safety instructions are in Chinese and English only. This is a minimum requirement especially safety rules and training material should be in Chinese and English.

3. What are the current practices in management of safety of ethnic minority workers in construction sites? (Any different treatment for ethnic minority workers).

No they is no different treatment for the EMWs.

Whether they understand the safety instructions or not?

Well, we remind our contractors to look at the needs of EMWs. If they need safety trainings the contractor has to arrange trainings sessions into their own language. But if they have only Chinese or English speaking safety trainers then they can only deliver the trainings into Chinese or in English.

4. What are the difficulties for ethnic minority construction workers to comply with safety rules and regulations?

I believe the difficulties in trainings. Whether the EMWs are given sufficient understanding of safety trainings and safety rules and regulation is a first question? Except this I don't see any major difference between a local and EM worker. If there are local or EMWs, they have to comply with safety rules and regulations. There shouldn't be any difference. Whether the workers understood the safety rules and regulation is the major concern.

Whether toolbox talks and morning briefing is carried out in Chinese and English?

Safety toolbox talks and morning briefings are bilingual i.e. Chinese and English.

5. Can you compare safety behaviour/attitude of ethnic minority construction workers with that of local workers?

It is very difficult to compare. If you look into the accident statistics, reportable injury rate, the percentage of injury rate of EMWs is higher in our construction sites. Some injuries caused to the EMWs may not be genuine around 10-15% of the cases may not be genuine.

N.B: It seems like there is curtail and they will try to pursue these workers by taking legal actions against their employers. From this kind of action, they are getting compensation. If one worker tried that gain, the others may also be followed by others. Other workers may have minor injuries and they will not come to the work. All the injuries will have to be reported to the Labour Department even those are minor cut or minor slip on a floor. The workers will disappear and will send legal notice. I can say some of them are very hardworking. But the accident statistics show that the number of injuries caused to the EMWs is higher than their local counterpart. Because more than 50% of injuries in this project caused to the EMWs although we don't have 50% of EMWs.

The statistics show that their safety performance is poor but a certain number injuries are not genuine. On the other hand I cannot give your any evidence that those are not genuine. Some EMWs are very hardworking and cooperating with their employer. Some of the EMWs have a great contribution to the project.

Do you think the local workers can also claim compensation benefit with fake injuries?

Yes, there could be some cases but relatively less. Some local workers may also taking advantage of the compensation system but relatively less in number.

Is it possible for the worker to get compensation from one employer and at the same time he can work on another work site?

Not within the recent years. In the past 4/3 of salary could have been reimbursed. Some of them were caught for fake compensation. Since the change of the law, the compensation salary has become 4/5. You can tell that there is no need to do any other type of work, especially by the EMWs. In a few cases, the workers have gone back to their home countries and they were taking the amount from compensation scheme.

6. Can you give any recommendations for improving safety performance of the ethnic minority construction workers?

Communication is very important. We need to identify the safety officers from the EM group so they could be trained. Then the industry would have more safety officers who can help the EMWs. This is not only affecting the project level EM staff but also the other government department. Such as in CIC trainings centres, all the trainings are carried out in Chinese or English. Some of the EM may not understand the Green Card safety trainings.

I suggest that the first Green Card Trainings Course by the CIC or other training institutes should be carried out in their native language. But the problem is where CIC and other institutes can get the EM safety trainers. If that will be made compulsory that will be difficult for the contractors to arrange such type of set up. Other problem may be if I have only a few EMWs why should I employ a full time EM safety officer. Therefore in my point of view, if CIC can arrange some EM trainers that may solve the problems of the EM communication problem.

7. Do you have any information about accident cases of ethnic minority construction workers?

We do not segregate or categorized or produced the statistics about different nationality accidents cases. Sometime we can make very quick check with the names of the reportable injury cases. But we cannot differentiate which nationality they belongs to but we can only tell they are non-local workers.

There are reports in the newspaper about the around 258 accidents cases were reported by the XXX to the Labour Department? Do you know the % of EM?

Well, if you want to ask about my project I can try to provide you. But for the overall XXX accidents cases I will not be able to report such accidents information.

8. What is the existing communication network structure?

Our written instructions are only in Chinese and English. Usually, any major problem or any major decision will be by the top management.

How many team members are in your safety department?

We have both contractual and management relationship by the XXX project level and contractor level.

Is there any requirement that for certain number of EMWs there should be EM safety supervisor?

No, we do not have such requirement but we do suggest to our contractors that if they have a lot of EMWs then defiantly they will think about hiring EM safety staff speaking the EM language. But the problem is they are not willing to employ and there are also not enough safety supervisor staff in Hong Kong, who is also fluent in tri-lingual.

There is also some other problems. For example one contractor trained and built capacity of EMWs and invest the resources on them. After getting trainings there might be better opportunities for that person they may switch to the new contractor. But still there are some contractors are trying to employ such EM safety staff because they have many EMWs.

9. What could be an effective communication network structure?

Yes, the current hierarchy is working very well. As a client, we don’t have much problems for not having EM speaking staff. But from the contractor point of view, if they have many EMWs they should have to have EM safety staff.

10. Whether, good safety performance staff has an effective communication structure?

Well not only effective communication but also culture will also affect the safety performance. At the construction site all the workers are not talking about the safety. They are also talking about how to carry out the work. So therefore, if the communication is not good, that will not only affecting the safety performance but also affecting the work progress. So it would be better if the whole team belongs to one EM (from supervisor to workers). I have also witnessed a good performing EM team.

When we need to pass the safety instructions EMWs, the EM supervisor who can also speak the native language, he can transmit the safety information effectively to the frontline workers. So it is one of the solution could be try to make small group for EMWs.

11. What are the main communication tools (e.g. mobile phone, body language) and means (language) used by the ethnic minority workers in construction sites?

We have translated some of the safety instructions/signage into different EM languages. We are also recording videos for safety demonstrations/instructions and let see if we will be able to have sub-titles into various other languages.

12. How frequently safety manager interacts directly with ethnic minority workers? Whether interpreters or translators are used for effective safety communication with ethnic minority workers?

It all depend how many EMWs are employed by the contractor. If there are more EM staff then they will interact more through interpreter. Most of the workers know basic English, if the English communication will not be a problem. If there will be any problem then a translator or interpreter is used.

13. What modes (formal and informal) of safety communication are used for ethnic minority workers by the safety manager in construction site? Who will the ethnic minority workers seek help in case of safety problems?

I have attended one of our contractor's safety promotion activities where they have higher percentage of EMWs. At the safety promotion activities, the supervisor will be translating from English into Nepalese language. For very important safety messages, they will translate into the EM language.

14. Whether safety trainings are conducted in ethnic minority native languages and whether safety instructions are translated into ethnic minority native languages?

15. What are the major safety communication problems of ethnic minority workers when communicating with local co-workers in construction sites?

I believe language is the major problem. Most of the local workers are also not fluent in English. A person with a poor English talking to a person with a poor understanding of English will create communication barriers.

I know some of the supervisors are fluent in tri-lingual but very few. Because most of the Nepalese workers were not born in HK and they can only speak basic English.

16. What are the key success factors of effective safety communication of ethnic minority workers in construction sites?

Same as to 17 question.

17. What measures should be taken to improve safety communication of ethnic minority workers in construction site?

Trainings into the EM native language can improve the communication problem. There is a need to create a supply of the EM safety trainers.

How about the local graduates are willing to work in this industry?

Well, the industry do not have problem of employing local or foreign (English speaking) safety staff. We only have problem of employing good and expert safety staff. The supply for safety staff is sufficient but the problem is we are lacking much safety professionals.

For example a contractor has 500 workers and they have only 50 EMWs. Can they employ a safety officer (who is tri-lingual). Yes, if there is supply they can employ. But there is no supply.

But if we make it compulsory that the contractor has to employ a safety officer if there are minimum number of workers that may also affect the local safety officers. It would be better if CIC try to create that supply by training those EM safety staff. The green card course is a first course that must be delivered into their native language.

18. Remarks: (what are your opinion about pay for safety scheme or XXX incentive scheme) How effective it is implemented?

We called Safety and Environmental Incentive Payment Scheme (www.expressraillink.hk/en/construction/safe_first.html).

•To recognised the contractors which excel in the aspects of quality, safety and environmental protection;

•HK$0.5 million award are sponsored by insurers to support XXX to promote work safety.

We pay for good safety performance. We are not paying the contractor for conducting safety meetings, for conducting trainings. In our contract requirement, the contractors have to provide safety trainings but we are not going to pay them for these trainings. We will only pay them if they achieve the better performance than our basic requirements. So some of the contractors' performance is based on the outcome. We put may be 30% of the incentive into accident prevention and if the contractors will have accidents then they will not be paid for the accident prevention amount. So therefore they try all their best to reduce the number of accidents and the action they usually need to do is promotions, conducting more trainings and enforcement of safety rules and that will affect all the workers.

For example, we have a contractor and they have major workforce of Nepalese. They have a number of reportable accidents by these EMWs. They have to identify why these accidents are happening? Whether the communication is one of the reason. We discuss with them and concluded that they have communication problem. So they have to find a safety supervisor from the market (construction sector) an EM person who is expert in safety. So this is not only an incentive scheme but also our safety management principle.

If the accident statistics show that the EMWs having more accidents then they will identify the solutions i.e. how to improve the safety performance of the EMWs. In our current contracts, there are not any special clauses addressing the EMWs safety. The safety budget is spent on safety promotion activities including improving site safety performance, housekeeping, winning award, welfare of employees etc.

Does the current XXX safety incentive scheme directly incentivizing the frontline workers?

No, I agreed that the scheme is not directly incentivizing the frontline workers. We cannot enforce into our scheme that the contractors have to pay certain amount for better safety performance to the workers. We are creating an atmosphere for completion for zero accidents.

But some of the contractors are practicing quarterly safety promotion activities. Some of them have monthly promotion schemes, where they have lucky draw for group of workers who do not have any accidents. Every worker on site is treated equally (local or EMWs) and lunch or dinner is arranged to the workers.

How this scheme can be improved so that the frontline workers can get benefit from this scheme?

Perhaps if the scheme can subsidise the salaries of workers. This can also be used to build capacity of the EMWs for safety trainings. It could also be included in the contract that if the contractors have certain number of EMWs then there should be safety staff to look after those EMWs and also subsidies can be provided for this extra person.

How this scheme can also benefit the local frontline workers as well?

Well we cannot specifically put into our incentive scheme that the contractors have to give money to the workers. We pay the contractors extra for good site condition, for having less accidents, winning the awards etc. All of these requirements not only provide incentives better than the usual welfare facilities. All these will benefits are for the workers.

If they achieve zero accidents we have certain amount of money. If there is improvement in the accidents with compare to last month, we have certain amount of money. If the contractors have better safety performance than our set targets then the contractors will also get some amount of money. If the contractor wanted to get that incentive scheme amount they have to prevent accidents from happening. No matter it is caused by the local or EMWs. The contractors have to control. We will not distinguish who caused the accidents.

We have another type of incentive i.e. if they achieve a certain level in our safety audit they will have certain amount of money. Achieving good incentive rating means that the site is in good condition. If the contractor will participate in safety award scheme organized by the Labour Department or CIC etc. if they won any award for safety (not only safety but also environmental) then they will also get certain amount of money. So the contractors are encouraged to improve their safety performance and participate in these kind of winning award schemes.

The contractors have kiosk for rest and also for portable drinking water, soft drink vending machine etc. which are benefiting all workers.

What are the penalties for not achieving the safety targets?

If the contractors will not achieve the safety auditing targets, their payments will be delayed. But we wouldn’t penalise them in the monetary term for not achieving our safety targets. We will not take out money from the contract sum.

The XXX incentive scheme is extra money which is different from the HK Government Pay for Safety Scheme (PfSS). Where the money for (PfSS) is taken out from the contract sum and then given back to contractor for achieving certain targets.

If the contractors put this incentive scheme money as part of their bidding price that is their (contractors) problem. But this money is extra to them (contractors), we are actually not paying them until they (the contractors) achieve the certain safety performance targets.

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